MARYLAND GEOLOGICAL SURVEY

UPPER CRETACEOUS

TEXT AND PLATES

MARYLAND

GEOLOGICAL SURVEY

UPPER CRETACEOUS

TEXT AND PLATES

BALTIMORE
THE JOHNS HOPKINS PRESS
1916

The Lord Baltimore Press

ΙΩΤΑ ΕΝ ΟΥ ΜΗ ΠΑΡΕΛΘΗ

CLASS PELECYPODA (CONTINUED)

Subgenus GRYPHÆOSTREA Conrad

[Am. Jour. Conch., vol. i, 1865, p. 15. Name only]

Type.—Ostrea subeversa Conrad = *Gryphæa vomer* Morton.

"Shell thin, elongate, straight, narrow; lower valve rather deep and smooth; upper valve flat or slightly concave, and ornamented with distant, regular, thin, concentric laminæ; beak of lower valve contorted, or turned to one side; cartilage-pit narrow, oblique.—*Gryphæa vomer* Morton (sp.). Mr. Conrad did not publish a diagnosis of this type, but merely gave the name in a list of fossils. At my request, however, he gave me in manuscript the above diagnosis, and mentioned the above type. I would add that, in perfectly preserved specimens, the typical species presents the singular peculiarity of throwing out *long,* slender, auricular appendages (one on each side) from the lower valve near the beak. These being very fragile, are nearly always broken away, as the specimens are found; but I observed several, with more or less of them preserved, in the New Jersey beds; and one I found growing in the inside of a *Gryphæa vesicularis* with them perfectly preserved and apparently attached to the *Gryphæa* by their extremities."—Meek, 1876.

Gryphæostrea suggests *Exogyra* in the gyrate umbones of the left valve, The beak of the right valve of the former, however, is orthogyrate or at the most slightly inclined, and this, together with the inflation of the beak of the left valve, allies it more closely with *Gryphæa* than with *Exogyra.*

GRYPHÆA (GRYPHÆOSTREA) VOMER Morton

Plate XXV, Figs. 1-4

Gryphæa vomer **Morton, 1828, Jour. Acad. Nat. Sci., Phila., vol. vi, p. 83.**
Gryphæa vomer **Morton, 1834, Syn. Org. Rem. Cret., p. 54, pl. ix, fig. 5.**
Gryphæa vomer **Conrad, 1835, Trans. Geol. Soc., Pennsylvania, vol. i, p. 336.**
Gryphæa vomer **Conrad, 1842, Proc. Nat. Inst., Bull. ii, p. 172.**
Exogyra lateralis **Meek, 1864, Check List Inv. Fossils N. A., Cret. and Jur., p. 6.**
Ostrea (Gryphæostrea) subeversa **Conrad, 1865, Am. Jour. Conch., vol. i, p. 15 (name only).**

Etymology: γρυπός, hook-nosed; *ostrea*, oyster.

Gryphæostrea lateralis Conrad, 1868, Cook's Geol. of New Jersey, p. 724.

" *Ostrea lateralis* Nilsson " Coquand, 1869, Mon. Genre Ostrea, p. 96, pl. xxx, fig. 10. (Not *Ostrea vomer* d'Orbigny, 1850, Coquand, Mon. Genre Ostrea, p. 39, pl. xvi, figs. 13-15. = *O. convexa* Say.)

Gryphæostrea vomer Meek, 1876, Rept. U. S. Geol. Survey, Terr., vol. ix, p. 11.

Ostrea vomer White, 1884, 4th Ann. Rept. U. S. Geol. Survey, p. 302, pl. xlviii, figs. 8-10.

Gryphæostrea vomer Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 195, pl. xxvi, figs. 11, 12.

Ostrea sp. Clark, 1895, Johns Hopkins Univ. Circ., vol. xv, p. 6.

Ostrea sp. Clark, 1896, Bull. 141, U. S. Geol. Survey, p. 88, pl. xxxix, figs. 3a-3c.

Ostrea subeversa Clark, 1896, Bull. 141, U. S. Geol. Survey, p. 93.

Ostrea (Gryphæostrea) subeversa Dall, 1898, Trans. Wagner Free Inst. Sci., vol. iii, pt. iv, p. 681.

Ostrea (Gryphæostrea) vomer Clark, 1901, Md. Geol. Survey, Eocene, p. 193, pl. 1, figs. 1-5.

Ostrea (Gryphæostrea) vomer Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 11.

Gryphæostrea vomer, Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 455, pl. xliv, figs. 7-11. (Exclude fig. 6, broken valve of *Gryphæa vesicularis*).

Description.—" Shell subrhomboidal; upper valve small, thin, slightly concave; lower valve convex, obscurely lobed, the lobed margin obliquely produced from the hinge; a wrinkled groove each side of the latter; beak pointed, curved obliquely inwards; umbo prominent."—Morton, 1828.

Type Locality.—New Egypt, New Jersey.

Shell of moderate size, elongate, rudely ovate or elliptical, strongly inequivalve; attached left valve strongly convex, often irregular in outline over the area of attachment in the umbonal region; umbones inflated, tips prosogyrate and acutely pointed, when not flattened against the supporting surface; anterior and posterior dorsal margins of perfect and typically developed individuals produced into long, slender, auricular extensions somewhat similar to those of *Gryphæa convexa* Say. External surface of left valve smooth excepting for growth striations, right cover-valve regularly subovate, flattened, often a little sinuous and with a slight forward twist in the flattened umbonal region; external surface sculptured with conspicuous, fine-edged concentric laminæ, five to eleven in number, regularly spaced, parallel to the outer margin and delimiting the outline of the shell during former stages of growth; hinge area small,

low, flattened as a rule, irregular in outline, submargins auriculately produced in the left valve, somewhat thickened but not produced in the right valve; not sculptured; muscle impressions elongated, rudely semi-elliptical, concentrically striated.

The characters of the attached valve of *G. vomer* are variable, the inflated umbones and smooth external surface constituting perhaps the best diagnostic of indifferently preserved individuals. The ovate outline and the elevated concentric laminæ are sufficient to determine even a fragment of the right valve.

Occurrence.—MATAWAN FORMATION. ? Gibson's Island, ? head of Magothy River, ? Ulmstead Point, Anne Arundel County, Maryland. MONMOUTH FORMATION. Two miles west of Delaware City on John Higgins farm, Briar Point, Post 156, Chesapeake and Delaware Canal, Delaware; Bohemia Mills, Cecil County; mouth of Turner's Creek, Kent County; Brightseat, railroad cut west of Seat Pleasant, Brooks estate near Seat Pleasant, Friendly, and McNeys Corners, Prince George's County, Maryland. RANCOCAS FORMATION. Noxontown Pond, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Marshalltown clay marl, New Jersey. *Monmouth Formation.* Navesink marl and Red Bank sand, New Jersey. *Rancocas Formation.* Vincentown limesand and Hornerstown marl, New Jersey. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, Lee and Alcorn counties, Mississippi. *Ripley Formation. Exogyra costata* zone, east-central and northern Mississippi. *Extreme top of zone,* Union County, Mississippi. *Selma Chalk. Exogyra ponderosa* zone, Warrior and Tombigbee rivers and Pickens County, Alabama; east-central and northern Mississippi and Tennessee. *Exogyra costata* zone, Sumter and Wilcox counties, Alabama; east-central and northern Mississippi. *Nanjemoy Formation.* Maryland. *Aquia Formation.* Maryland. *Jackson Formation.* Alabama.

Superfamily TRIGONIACEA

Family TRIGONIIDAE

Genus TRIGONIA Bruguière

[Ency. Méth. Vers., vol. I, 1789, p. xiv]

Type.—Trigonia margaritacea Lam.

Shell heavy, nacreous within, equivalve, inequilateral, subtrigonal or trapezoidal in outline. Umbones anterior, opisthogyrate, moderately inflated, lunule absent, escutcheon strongly defined; posterior area sharply differentiated by a carina extending from the umbones to the posterior ventral margin; sculpture upon medial and anterior portions of the disk usually developed and often more or less nodose; sculpture upon the posterior area concentric, radial, divaricate, or absent. Hinge dentition vigorous, two divergent transversely striated cardinal teeth in the right valve, three cardinals in the left, the middle tooth stout, trigonal, medially sulcate, transversely striated, the two outer cardinals compound and relatively small, transversely striated within. Ligament groove marginal, opisthodetic, muscle impressions two in number, the posterior the larger, pallial line indistinct, entire.

Trigonia was one of the major elements during the Mesozoic, the epoch which marks its origin and culmination. Five species still persist in the Australian region, but they are rather distantly connected with the Mesozoic forms.

A. Costals not exceeding 16 in number .... *Trigonia eufalensis*
B. Costals exceeding 16 in number.
  1. Shell semi-elliptical in outline, not rostrate posteriorly, costals coarser upon the medial portion of the shell than towards the extremities .... *Trigonia cerulea*
  2. Shell trigonal in outline, rostrate posteriorly, costals conspicuously coarser on the anterior third of the shell, becoming abruptly finer and more regular in arrangement medially. *Trigonia marionensis*

TRIGONIA EUFALENSIS Gabb

Plate XXXIV, Figs. 1, 2

Trigonia eufalensis Gabb, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 396, pl. lxviii, fig. 32.

Trigonia eufalensis Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 9.

Etymology: τρι, three; γωνία, angles.

Trigonia eufalensis Conrad, 1868, Cook's Geol. of New Jersey, p. 725.
Trigonia eufalensis Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 113, pl. xiv, figs. 1-4.
Trigonia eufalensis Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 11.
Trigonia eufalensis Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 462, pl. xlviii, figs. 5-10.

Description.—" Subtriangular, resembles *T. alæformis* Sow. in outline, not quite so elongate anteriorly; beaks posterior; lunule distinct; surface marked by about fourteen ribs, the more anterior of which proceed from the lunule anteriorly and then cross the shell at right angles with the lunule, exhibiting a tendency to being nodose, especially near the lunule; lunule marked by ten or twelve transverse ribs; cardinal margin somewhat incurved, anterior elongate and subbiangular, basal sinuous and deeply serrate, posterior regularly rounded; internally, hinge teeth small, muscular impressions deep; pallial line entire; a small tooth-like ridge or process extends along the middle of the alation, as in *T. alæformis*."—Conrad, 1860.

Type Locality.—Eufaula, Alabama.

Shell thick, heavy, prismatic, rudely trigonal in outline, moderately convex; umbones anterior, incurved, opisthodetic, flattened upon their summits but prominent by reason of their position at the apex of an angle of approximately 120°; lunule not differentiated, escutcheon defined, not only by the sculpture but also by an abrupt change in the plane of the shell; anterior portion of the shell sculptured by twelve to fifteen prominent concentric ridges, rather sharply rounded upon their summits, dorsally inclined, especially in the umbonal region, more prominent, symmetrical and feebly rugose ventrally, regularly arranged but much more closely spaced along the concave margin than the convex; ligament marginal—the groove in which it was lodged short linear and opisthodetic; cardinal teeth of left valve massive, trigonal, transversely striated, inner faces of hinge margins also striated in order to clasp the divergent teeth of the right valve; muscle impressions deeply excavated, the anterior slightly more so than the posterior; pallial line simple—distant from the hinge margin.

This species is the smallest and most abundant member of this remarkable genus within the confines of Maryland. It is separated from *T. cerulea* Whitfield by the more prominent umbones, the more convex posterior dorsal, the more attenuated posterior extremity and the fewer rugose and relatively coarser external costæ.

Occurrence.—MONMOUTH FORMATION. ? 2 miles west of Delaware City on John Higgins farm, Delaware; ? Bohemia Mills, Cecil County; mouth of Turner's Creek, Kent County; Brightseat, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly, McNeys Corners, Fort Washington, Prince George's County, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, Woodbury clay and Wenonah sand, New Jersey. *Black Creek Formation.* North and South Carolina. *Peedee Sand.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras subzone,* Georgia. *Ripley Formation. Exogyra costata* zone, Georgia; Eufaula, Alabama. *Extreme top of zone,* Pataula Creek, Georgia.

TRIGONIA CERULEA Whitfield

Trigonia cerulea Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 114, pl. xiv, fig. 7.

Trigonia cerulea Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 464, pl. xlviii, fig. 13.

Description.—" Shell small or below a medium size, moderately convex on the valves and of a triangularly-ovate outline. Beak small, appressed, obtusely pointed and erect; posterior hinge-line long and slightly concave; posterior end narrow and rounded; anterior end broadly rounded; basal line a litle gibbous in the middle, but otherwise forming a continuous line with the anterior and posterior margins. Surface of the shell covered by coarse elevated ribs, which are flattened on their surfaces over a large part of the shell, but near the posterior cardinal margin are sharp and very slightly crenulated. The ribs are coarse and distant on the anterior and middle parts of the shell, but gradually become finer and more

closely arranged toward the posterior part. Interspaces concave. No postero-cardinal area is visible on the specimen used, the ribs apparently passing, without interruption, across the entire disk of the shell and terminating on the cardinal margin. The ribs of the anterior end curve strongly forward in passing to the basal and anterior margins, while those of the hinder parts of the valves pass more directly across to the postero-basal margin. This species differs from any of the others described from these beds in its form, but more particularly in the style and number of the surface ribs. They are more numerous than on any of the other forms, there having been about twenty-three on the specimen figured, which is only one inch and an eighth in length. Their flattened surface and the gradual increase backward is also opposite from that which is seen to occur on those . . . . In coarse olive-green indurated marl at the deep cut on the Holmdel and Keyport Turnpike, Monmouth County, New Jersey, at the base of the Lower Marls. The substance of the shell is entirely changed to vivianite, which is soft and of a bright blue color, very easily destroyed by handling or rubbing."—Whitfield, 1885.

This species is represented in the collections of the Maryland Cretaceous by a single valve. The species is somewhat larger than the more common *T. eufalensis* Gabb, is less trigonal and more semi-elliptical in outline, not rostrate posteriorly and less coarsely and more uniformly sculptured.

Occurrence.—MONMOUTH FORMATION. Brooks estate near Seat Pleasant, Prince George's County.

Collections.—Maryland Geological Survey, Columbia University, New Jersey Geological Survey.

Outside Distribution.—*Monmouth Formation.* Tinton beds, New Jersey.

TRIGONIA MARIONENSIS Stephenson n. sp.

Description.—" Shell subtrigonal, equivalve, inequilateral, moderately ventricose anteriorly, becoming strongly compressed posteriorly; beak small, incurved, situated about one-quarter the length of the shell from the anterior extremity. Hinge and dorsal area too poorly preserved for description.

" Posterior adductor scar apparently small and situated near the dorsal margin, at about the mid-length of the shell; a sharp crested ridge or carina extends from a short distance behind this scar backward to about the middle of the posterior extremity. Dorsal margin broadly concave; anterior margin broadly and regularly rounded; ventral margin regularly rounded anteriorly, notched, the notches corresponding to the interspaces between the ribs; the broad curve carries the ventral margin upward toward the high narrow posterior portion of the shell, where the margin curves slightly downward becoming concave, and meeting the posterior margin in a subright angle; posterior margin short, squarely truncated, and situated above the mid-height of the shell.

" Surface of the adult marked by 20-22 prominent ribs which originate along the lower margin of the dorsal area and extend to the anterior and ventral margins; the ribs on the anterior portion of the shell trend first forward and downward, and then sweep in a gentle curve around to the anterior margin; from the front toward the rear the ribs become successively straighter, tending first downward, and, toward the posterior extremity, backward and downward; the crests of the ribs are poorly preserved but are apparently tuberculated.

" *Dimensions.*—Length 37 mm.; height 27 mm.; convexity 7 mm.

" This species differs from *Trigonia eufaulensis* Gabb in the closer spacing and smaller degree of curvature of the ribs, and in the greater curvature of the ribs, and in the greater elongation of the posterior portion of the shell. The species is distinguished from the young of *Trigonia bartrami* by the relatively closer spacing of the ribs and the greater posterior elongation of the shell.

" *Type.*—U. S. National Museum, No. 31642.

" *Occurrence in South Carolina.*—Snow Hill member of Black Creek formation (upper part of *Exogyra ponderosa* zone). Hodge's old mill site, 3½ miles southeast of Mullins, Marion County.

" *Occurrence in Alabama.*—Tombigbee sand member of Eutaw formation (lower part of *Exogyra ponderosa* zone). Seaboard Air Line Railway at bridge over Hatchechubbee Creek, 2 miles west of Pittsview, Russell County."—Stephenson, MS.

Occurrence.—MATAWAN FORMATION. North shore Round Bay, Severn River, Anne Arundel County. MONMOUTH FORMATION. Millersville, Anne Arundel County.

Collections.—Maryland Geological Survey, U. S. National Museum.

C. Isodonta

Superfamily PECTINACEA

Family PECTINIDAE

Genus PECTEN Müller

[Zool. Dan Prodr., 1766, p. 248]

Type.—*Ostrea maxima* Linné.

Shell approximately equilateral, inequivalve, usually suborbicular, auriculate; right valve, as a rule, the more convex, not adherent but attached by a byssus; hinge line straight; resilium central, internal, triangular; interlocking grooves and ridges diverging from the apex of the resilial pit; pallial line simple; monomyarian; adductor impression rounded, posterior.

The earliest *Pecten* known is from the Cretaceous. The recent species exceed two hundred in number and their distribution is world-wide.

A. Shell not conspicuously inequivalve.
  1. External surface radially sculptured.
    a. Radial sculpture of more or less arcuate linear liræ. *Pecten argillensis*
    b. Radial sculpture coarse to fine but not linear nor arcuate.
      i. Adult shell exceeding 3 cm. in diameter; radials not sulcate, more or less scabrous, 30 to 40 in number. *Pecten whitfieldi*
      ii. Adult shell not exceeding 3 cm. in diameter; radials medially sulcate, as a rule, but not scabrous, 12 to 18 in number.............................*Pecten venustus*
  2. External surface not radially sculptured.
    a. External surface faintly sculptured concentrically.
      i. Adult shell exceeding 2 cm. in diameter. *Pecten cliffwoodensis*
      ii. Adult shell not exceeding 2 cm. in diameter..*Pecten conradi*
    b. External surface smooth, adult shell not exceeding 2 cm. in diameter ....*Pecten simplicius*
B. Shell conspicuously inequivalve...................*Pecten quinquecostatus*

Etymology: *Pecten*, a comb. A reference to the series of small tooth-like spines placed on the margin of the shell at the byssal opening.

PECTEN ARGILLENSIS Conrad

Plate XXXIV, Figs. 3-5

Pecten argillensis Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2 ser., vol. iv, p. 283.

Pecten argillensis Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 7.

Camptonectes bellisculptus Conrad, 1869, Am. Jour. Conch., vol. v, p. 99, pl. ix, fig. 11.

Camptonectes (Amusium) burlingtonensis Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 53, pl. viii, figs. 3-7, 9 (not fig. 8) *(ex parte)*; not *Pecten burlingtonensis* Gabb, 1860.

Pecten bellisculptus Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 11.

Pecten argillensis Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 472, pl. xlix, figs. 1-4.

Description.—" Suborbicular, very thin, compressed; radiated only on the upper part with minute lines; disk covered with closely arranged, fine lamelliform striæ, except on the umbo and adjacent parts where they are distant; posterior margin opposite the ear carinated. (Upper valve.)"—Conrad, 1860.

Type Locality.—Owl Creek, Tippah County, Mississippi.

Shell rather thin and fragile, compressed, subequivalve; outline, exclusive of the auricles, a sector of approximately 90°; hinge line straight, a little more than half as wide as the shell; auricles broad but rather low; surface ornamentation elaborate but not conspicuous, radial sculpture of finely incised lines, two to four to the millimeter, on the disks of the adults, straight in the medial portion but sweeping in gentle curves toward the lateral margins deeper and a little broader posteriorly than anteriorly; concentric lines thirty to forty in number, over-riding and intercepting the radials, finely and evenly crenulated and in the umbonal region of perfectly preserved adults, minutely moniliform; auricles very unequal, the anterior broader and relatively lower than the posterior; posterior auricle sculptured with approximately fifteen coarse lirations running oblique to the hinge margin, rendered minutely scabrous by the over-riding incrementals; anterior auricle long and narrow, alate in outline, the striations radiating from the umbonal extremity, sweeping in rather abrupt curves to the dorsal margin; byssal sinus narrow and very

deep; the area between the auricle and the disk not sculptured; characters of interior not known.

Pecten argillensis is identical with *Pecten bellisculptus* Conrad, which was doubtless described from a type on which the delicate beaded sculpture was better preserved than on the type of *P. argillensis* Conrad. The species is one of the most abundant representatives of its genus in Maryland, but unfortunately it is so fragile that perfectly preserved individuals are obtainable only with the greatest difficulty.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, 1 mile west of Friendly, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, Woodbury clay, Marshalltown clay marl, and Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, New Jersey. ? *Black Creek Formation.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Lowndes County, and ? Prentiss County, Mississippi. *Ripley Formation. Exogyra costata* zone, Georgia; Eufaula, Alabama; Chickasaw, Union and Tippah counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Chattahoochee River, Alabama; Lowndes and Union counties, Mississippi.

PECTEN WHITFIELDI Weller

Pecten tenuitestus Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 47, pl. vii, figs. 5, 6. (Not *Pecten tenuitestus* Gabb, 1862.)

Pecten whitfieldi Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv. p. 468, pl. l, fig. 14.

Description.—" Shell of small to medium size, broadly ovate exclusive of the auriculations, the breadth of the shell being to the height as six is to seven. Cardinal slopes straight, more than one-third the length of the shell, and the anterior longest. Left valve very depressed convex, most ventricose above the middle; beak small and pointed. Auriculations large, the anterior double the size of the posterior, very slightly rounded on the

margin, and perceptibly narrowing below; posterior shorter on the cardinal line than below; anterior side marked by seven sharply-elevated nodose rays, and the posterior by six, with one or two smaller ones between, near the body of the shell. Body of the shell marked by about thirty to thirty-five slender, rounded but unequal rays with much wider flattened interspaces, with an occasional incipient ray on the outer third of the shell. Ribs marked by distant, elevated or subspinose nodes, most closely arranged on the auriculations and obsolete above the middle of the body of the valve. Right valve with the ribs proportionally stronger in the specimens examined than on the left valve and showing a stronger tendency to alteration of smaller and larger ones than on the opposite, while the imbrications of the ribs are not nearly so strong, not rising into spines, as on the left valve. Auriculations of the right valve scarcely perceptibly radiate, while the concentric markings of the valve are more subdued throughout.

"So far as I have discovered the species was never figured by its author, but its description is more full than usual, so I think the identification is less likely to be questionable than in some other instances. It would seem to be the type of *Pecten islandicus,* although the ribs are less closely arranged and the interspaces are flattened. Among the few specimens which I have examined I have seen no reason to suppose the valves were so strongly bent as to leave them 'about half an inch apart in the middle,' as the author states.

"*Formation and Locality.*—In the Lower Green marls at Holmdel, New Jersey, collected at G. C. Schanck's pits, near Marlborough, and presented to the New Jersey collection by the Rev. Dr. Riley. It also occurs at Burlington, New Jersey."—Whitfield, 1885.

"Shell, exclusive of the auriculations, broadly ovate in outline, higher than wide, the dimensions of a left valve being: height 40 mm., width 35 mm., convexity 5 mm., length of hinge-line about 16 mm. Left valve depressed convex, deepest above the middle, the beak pointed, auriculations of moderate size, the anterior one larger than the posterior. Surface marked by low, rounded, nodose, more or less unequal, radiating ribs, which increase by intercalation, thirty or more are present upon the body

of the shell where they are narrower than the interspaces, the ribs upon the auriculations are narrower, closer together, and more nodose than upon the body of the shell, though in some examples, especially the larger ones, they are inconspicuous. The surface is also marked by more or less irregular, concentric lines of growth.

"*Remarks*.—The shells which are made the types of this species were identified and illustrated by Whitfield as *P. tenuitestus*, but an examination of Gabb's type of that species has shown that Whitfield's identification was incorrect, the true *P. tenuitestus* being the same as the specimens described as *P. planicostatus* by that author. This species differs from *P. tenuitestus* of the same fauna, in being proportionally higher, narrower, and more convex, with the radiating ribs nodose, and proportionally broader with narrower interspaces and with the concentric markings coarser and less regular."—Weller, 1907.

A fragment of a multicostate scabrous *Pecten* occurs at Brooks estate, Prince George's County, and may perhaps indicate the former presence of this species in Maryland. Fragments of another species, possibly closely allied with *P. whitfieldi* Weller, were collected in the Matawan at Camp Fox on the Chesapeake and Delaware Canal. The Matawan form has much more numerous costæ which are rendered scabrous by the overriding concentric sculpture.

Occurrence.—MONMOUTH FORMATION. Brooks estate near Seat Pleasant, Prince George's County.

Collections.—Maryland Geological Survey, Columbia University, New Jersey Geological Survey.

Outside Distribution.—*Monmouth Formation*. Navesink marl, New Jersey.

PECTEN VENUSTUS Morton

Plate XXXIV, Figs. 6, 7

Pecten venustus Morton, 1833, Am. Jour. Sci., 1st ser., vol. xxiii, p. 293, pl. v, fig. 7.

Pecten venustus Morton, 1834, Syn. Org. Rem. Cret. Group, U. S., p. 58, pl. v, fig. 7.

Pecten venustus Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 7.

Pecten venustus Conrad, 1868, Cook's Geol. of New Jersey, p. 725.
Pecten venustus Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 45, pl. vii, figs. 1, 2.
Pecten venustus Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 11.
Pecten venustus Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 478, pl. li, figs. 1-5.

Description.—" Shell thin, depressed, about half an inch in diameter, with fifteen or twenty double costæ; those on the lower valve delicately beaded. From New Jersey."—Morton, 1833.

Shell small, rarely more than a centimeter and a half in diameter, more than moderately inflated, subequilateral excepting for the auricles, a little higher than wide, dorsal margins converging at an angle of approximately 90°, lateral ventral margins roughly subscribing the major portion of a circle; external surface sculptured with some fifteen radial costæ broader toward the ventral margin and for the most part medially sulcate, interradials deeply channeled, usually narrower than radials; auricles unequal, the posterior smooth and rudimentary, the anterior narrow, elongate, distally truncate, sculptured with four or five subequal liræ; byssal notch rather shallow; interior plicated in harmony with the eternaxl sculpture.

Pecten venustus Conrad is the only one of the small *Pectens* that develops a vigorous radial sculpture.

Occurrence.—MATAWAN FORMATION. Post 236, Camp Fox, Post 218 and Post 192, Camp U & I, Chesapeake and Delaware Canal, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Marshalltown clay marl, New Jersey. *Monmouth Formation.* Navesink marl, Red Bank sand and Tinton beds, New Jersey. *Ripley Formation. Exogyra costata* zone, Chickasaw and Union counties, Mississippi. *Selma Chalk. Exogyra costata zone,* Sumter County, Alabama; east-central Mississippi.

PECTEN CLIFFWOODENSIS Weller

Pecten cliffwoodensis Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 469, pl. l, figs. 7, 8.

Description.—"The dimensions of an average specimen, a left valve, are: Height 30 mm., width 27.5 mm., convexity 4 mm., length of hinge line 14 mm. The body of the shell broadly subovate in outline; the beaks situated a little back of the middle of the hinge line, the auriculations moderately large and sharply differentiated, the anterior ones somewhat larger than the posterior, the cardinal slopes diverging from the beak at an angle of 90° or a little more, nearly straight or slightly concave, terminating at the sides of the shell above the middle of its height. The valves subequally depressed convex, the right valve if anything slightly flatter than the left, with a moderately deep byssal sinus. Surface of both valves nearly smooth, marked only by fine concentric lines of growth which continue across the auriculations, and on the anterior ear of the right valve become stronger than elsewhere on the shell. One imperfect specimen which seems to be a member of this species had a height, when complete, of about 50 mm., but the dimensions given above are those of a specimen of about average size. Some of the smaller individuals do not exceed 12 mm. in height. With the growth of the shell the proportionate width seems to increase. This species is unlike any of the other *Pectens* in these New Jersey faunas, but in general form and size the shells most closely resemble some individuals of *Pecten bellisculptus* Con.; the two species can always be distinguished, however, by their surface markings."—Weller, 1907.

Type Locality.—Cliffwood Point, Middlesex County, New Jersey.

A cast of a single valve which presents no characters by which it can be separated from *Pecten cliffwoodensis* Weller was collected at Arnold Point, on the Severn River in Anne Arundel County.

Occurrence.—MATAWAN FORMATION. North shore Round Bay, Severn River, Anne Arundel County.

Outside Distribution.—*Magothy Formation.* Cliffwood clay of New Jersey.

PECTEN CONRADI (Whitfield) Johnson

Pecten simplicus Conrad, 1868, Cook's Geol. of New Jersey, p. 725.
(Not Pecten simplicius Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 283, pl. xlvi, fig. 44.)
Sinsyclonema ? simplicia Conrad, 1869, Am. Jour. Conch., vol. v, p. 99, pl. ix, fig. 20.

Amusium conradi Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 52, pl. vii, figs. 8-10.

Pecten conradi Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 12.

Pecten conradi Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 474, pl. l, figs. 1-4.

Description.—" Shell small, seldom exceeding half an inch in height; erect-ovate, becoming more elongate proportionally with increased growth. Valves slightly convex. Hinge short, from half to two-thirds as long as the width of the body of the shell, strongly and distinctly auriculated. Beaks of the valves small and pointed, and the cardinal slopes long, straight or slightly concave, extending to near the point of greatest width of the body of the shell. Left valve smooth or but faintly marked by fine concentric lines, and a few (five or six) very faint radii. Ears smaller than in the opposite valve, both sloping toward the beak on the outer margin. Right valve marked with crowded concentric folds or elevated lines; also by five or six radiating lines; not always present. On most specimens there are distinctly rounded concentric folds or varices, but on some they are thin, sharp lines; always more crowded and usually finer toward the front, in adult specimens. Ears very distinct; that of the posterior side sloping toward the beak and the anterior one rounded at the extremity and deeply notched.

" This shell is very closely allied to *P. simplicus* Conrad, but differs in being more elevated and in the surface markings, that one being generally smooth or imperceptibly marked. In making these comparisons I have used a number of each valve of the present species from New Jersey, and a fine series of *A. simplicum* from the typical locality, Eufaula, Alabama, and it leaves no doubt in my mind as to their complete specific distinction." —Whitfield, 1886.

Type Locality.—Haddonfield, New Jersey.

A single valve from the Matawan of Anne Arundel County has been rather dubiously referred to this species because of the size and general outline and the faint traces of a concentric sculpture.

Occurrence.—MATAWAN FORMATION. Ulmstead Point, Anne Arundel County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl and Woodbury clay, New Jersey. *Monmouth Formation.* Navesink marl (rare), New Jersey.

PECTEN SIMPLICIUS Conrad

Plate XXXIV, Figs. 8, 9

Pecten simplicius **Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser, vol. iv, p. 283, pl. xlvi, fig. 44.**

Sincyclonema ? simplicus **Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 7.**

Pecten simplicus **Conrad, 1868, Cook's Geol. of New Jersey, p. 725.**

Sincyclonema simplicus **Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 319.**

Amusium simplicum **Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 51, pl. vii, figs. 11, 12.**

Pecten simplicius **Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 480, pl. li, fig. 6.**

Description.—" Ovate, thin, smooth and shining; ears moderate, nearly equal; both valves slightly convex; the upper valve slightly tumid on the umbo; inner margin minutely crenulated."—Conrad, 1860.

Type Locality.—Eufaula, Alabama, or Tippah County, Mississippi.

Shell small, smooth, lustrous, moderately compressed, the left valve a little more so than the right; anterior and posterior lateral margins converging at an angle of from 70° to 90°, base broadly and evenly arcuate; hinge-line straight, a little less than half the latitude of the shell, auricles small, trigonal, the anterior slightly larger than the posterior and sinuated in the right valve to accommodate the byssus; sinuses between the auricles and the disk clearly defined; external surface highly polished, smooth excepting for faint incremental striations and an occasional microscopically fine radial shagreening; characters of the interior unknown.

This *Pecten,* in spite of its small dimensions, is a conspicuous factor in the Cretaceous marls of Maryland by reason of its wide distribution and its shining surface. This shell is so thin and flaky, however, that for all it is so common it has not been possible to separate any one of the forms from its matrix.

P. simplicius Conrad has been confused in the synonymies with *P. conradi* Whitfield, a slightly larger shell which is characterized by the development of sharp, elevated, concentric lamellæ, approximately fifteen in number. The typical forms of the two species are conspicuously distinct but some of the peripheral members are difficult to separate.

Occurrence.—MATAWAN FORMATION. Ulmstead Point, Anne Arundel County. MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly, and McNeys Corners, Prince George's County.

Collections.—Maryland Geological Survey, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Monmouth Formation.* Red Bank sand and Tinton beds, New Jersey. *Black Creek Formation.* North and South Carolina. *Peedee Sand.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Georgia. *Ripley Formation.* *Exogyra ponderosa* zone, Union Springs, Alabama. *Exogyra costata* zone, Georgia; Eufaula, Alabama. *Extreme top of zone,* Pataula Creek, Georgia; Chattahoochee River, Alabama; Lowndes County, Mississippi.

PECTEN QUINQUECOSTATUS Sowerby

Plate XXXIV, Fig. 10

Pecten quinquecostatus Sowerby, 1814, Min. Conch., vol. i, p. 122, pl. lvi, figs. 4-8.

Pecten versicostatus Lamarck, 1819, Anim. sans Vert., vol. vi, p. 181.

Pecten quinquecostatus Brongniart, 1822, Géol. des Env. Paris, pl. iv, fig. 1.

Pecten quinquecostatus Nilsson, 1827, Petrif. Suecana, p. 19, tab. ix, fig. 8; tab. x, fig. 7.

Pecten quinquecostatus Morton, 1830, Am. Jour. Sci., 1st ser., vol. xvii, p. 285; vol. xviii, pl. iii, fig. 5.

Pecten versicostatus Deshayes, 1832, Enc. Méth., t. 3, p. 727.

Pecten quinquecostatus Morton, 1834, Syn. Org. Rem. Cret. Group U. S., p. 57, pl. xix, fig. 1.

Pecten quinquecostatus Goldfuss, 1836, Petrif. Germ., t. 93, fig. 1.

Pecten quinquecostatus Bronn, 1838, Lethæa Geogn., Bd. ii, pp. 678-680, taf. xxx, fig. 17.

Janira quinquecostata d'Orbigny, 1846, Paléont. Franc. Terr. Crét, vol. iii, p. 632, pl. ccccxliv, figs. 1-5.

Janira mortoni d'Orbigny, 1850, Prod. Paléont. Strat., vol. ii, p. 253.

Pecten quadricostatus var. Roemer, 1852, Kreide. von Texas, p. 64, pl. viii, figs. 4a-4c.

Pecten quadricostatus Shumard, 1854, Marcy, Expl. Red River, Louisiana, p. 178, pl. ii, figs. 2a, 2b; pl. iii, fig. 6.

Neithea mortoni Gabb, 1862, Proc. Acad. Nat. Sci., Phila. for 1861, p. 365.

Neithea mortoni Meek, 1864, Check List Inv. Fossils N. A., Cret. and Jur., p. 7.

Neithea mortoni Conrad, 1868, Cook's Geol. of New Jersey, p. 725.

Pecten quadricostatus Credner, 1870, Zeitsch. deutsch. geol. Gesell., Bd. xxii, p. 232.

Vola quinquecostata Stoliczka, 1871, Mem. Geol. Survey India, Palæont. Indica. Cret. Faunas of Southern India, vol. iii, p. 437, pl. xxxi, figs. 1-6; pl. xxxviii, figs. 4-9.

Neithea quinquecostata Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 56, pl. viii, figs. 12-14.

Neithea quinquecostata Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 481, pl. li, figs. 7-12.

Vola quinquecostata Böse, 1910, Bol. Inst. Geol. Mexico, p. 99, pl. xv, figs, 19, 20.

Description.—" Subtriangular, rather oblique, front semicircular, toothed; convex valves gibbous, ribbed, principal costa six, with four lesser ones between each; surface finely transversely striated. Upper valve flat-toothed. The obliquity of this shell is slight, the length not much greater than the width; the lines of growth frequently being deep and crossed by the ribs give the shell a fringed or furbellowed aspect; the flat valve has diverging striæ and notches corresponding in number with the costæ upon the hollow valve. The whole surface is covered with minute transverse striæ, which in the chalk specimens are often nearly obliterated. Figs. 4 and 5 are from the Sussex chalk near Lewes, by favor of G. A. Mantell, Esq.; they very much accord with those of the green sand from Wiltshire, figured below, but appear to be longer, and to have the transverse striæ of growth very remarkable. The shell represented at fig. 5 is a curiosity, showing the inner side of the flat valve, which is slightly convex within. I gathered the small shell, fig. 6, at Chute farm, it is a young deep under-valve, with the transverse striæ of growth neatly arching between the larger six costæ. Figs. 7 and 8 show the upper and under valves of different specimens, they are from the green sand at Chute, and are chiefly siliceous; for the use of one I am indebted to Thomas Meade, Esq. Such are said

to be found at Devizes and Blackdown, with the upper valve. It is possible that these are different species from those in the Chalk, the costæ are less prominent, and the striæ more distinct; at present, however, I can consider them only as varieties. Tab. 56, fig. 3, represents a specimen in ferruginous sandstone from Chute, which may possibly prove to be a distinct species. Its length exceeds its breadth by one-fifth, and on the sides of the larger costæ are two lesser ones, which are partly blended with them; the surface is nearly smooth. I have only seen this specimen."—Sowerby, 1812.

Shell rather large for a Cretaceous *Pecten*; cordate, very strongly inequivalve, subequilateral, lower valve highly convex, the upper flattened or feebly concave; maximum diameter at or a little behind the median horizontal; umbone of right valve very prominent, evenly inflated, rising well above the hinge line, orthogyrate; dorsal margins diverging at an angle of approximately 90°, produced so that the ventral and lateral margins subscribe an arc of only about 180°; external surface of lower valve sculptured with five or rarely six elevated, evenly rounded primaries, subequal in size and spacing and between each pair three or four more or less equal secondaries; submargins sculptured with rather fine close-set radials five in number, as a rule; ornamentation of upper valve more uniform in character, usually of twenty to twenty-five subequal and equispaced, well rounded and elevated radials; incremental sculpture fine and sharp; hinge line rather short, not far from five-ninths of the maximum latitude, overhung by the umbo of the right valve; auricles only slightly unequal, the anterior a little more produced and relatively lower and less strongly lirate than the posterior; posterior auricle receding below the hinge line, the anterior feebly constricted to form the byssal notch; characters of interior of shell not known.

The identity of the American species with the European has been questioned since the day of d'Orbigny. The Maryland representation is very meager and offers very little assistance toward the solution of the problem. As in *Pycnodonte vesicularis* the true affinities of the group should be worked out once for all by an exhaustive study of material from all the representative localities. If the two forms prove distinct Sowerby's name

must be retained for the European fossil and d'Orbigny's *mortoni* substituted for the American. It is the personal conviction of the writer that the two forms are identical, or at least that they cannot be separated on a geographical basis. D'Orbigny's criterion certainly will not stand, *i. e.,* that the American form differs from the European in the presence of five instead of four secondaries between each pair of primaries. The normal number in the American form is four as it is in the European and South Indian, but as in the foreign types this number is occasionally increased to five or reduced to three. The outline and relative proportions vary within rather narrow limits throughout the occurrence, and though there is a suspicion that the maximum diameter may fall a little nearer the median horizontal in the American individuals, this cannot be verified without the examination of much more material than is available at present.

Occurrence.—MAGOTHY FORMATION. Good Hope Hill, District of Columbia. MATAWAN FORMATION. Post 236, Camp Fox, Chesapeake and Delaware Canal, Post 192, Camp U & I, Chesapeake and Delaware Canal, Delaware. MONMOUTH FORMATION. Two miles west of Delaware City on John Higgins farm, Delaware; ? Fredericktown, Cecil County; Waterbury, Anne Arundel County, Maryland. RANCOCAS FORMATION. ? Noxontown Pond, Delaware.

Collections.—Maryland Geological Survey, New Jersey Geological Survey, U. S. National Museum, Geological Survey of India.

Outside Distribution.—Matawan Formation. Merchantville clay marl, Marshalltown clay marl, New Jersey. *Monmouth Formation.* Navesink marl, New Jersey. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Georgia; Russell County, Warrior River and Tombigbee River, Alabama; Tombigbee River, Mississippi. *Ripley Formation. Exogyra costata* zone, Georgia; Chattahoochee River, Alabama; Wilcox, Pontotoc and Chickasaw counties, Mississippi. *Selma Formation. Exogyra ponderosa* zone, Monroe and Prentiss counties, Mississippi; Tennessee. *Exogyra costata* zone, Tombigbee River, Alabama; east-central Mississippi; Lee, Clay and Alcorn counties, Mississippi. *Cenomanian.* ? Mexico, and England. *Turonian.*

Central Europe. *Senonian.* Central Europe. *Ootatoor Formation.* Southern India. *Trichinopoli Formation.* Southern India. *Arrialoor Formation.* Southern India.

Family LIMIDAE

Genus LIMA (Bruguière) Cuvier

[Tableau élémentaire d'histoire naturelle, 1798, p. 421]

Type.—Ostrea lima Linné.

Shell auriculate, auricles unequal; outline usually ovate, scoop-shaped and obliquely truncated laterally; valves closed inferiorly but gaping anteriorly and sometimes posteriorly; exterior surface rarely smooth, generally sculptured with simple or imbricated radial striæ; umbones rather prominent and distant; hinge edentulous; ligament internal, lodged in a subumbonal pit; pallial line simple; single muscular scar excentric, nearer to the posterior than the anterior margin.

A genus indicated in the Carboniferous, culminating in the Cretaceous and sparsely represented in nearly all the recent seas by white or colorless shells, which may be attached by a byssus or may swim freely with a motion similar to that of *Pecten.*

A. Both anterior and posterior auricles developed.
  1. Radial sculpture overridden by the concentric on the medial portion of the shell .... *Lima reticulata*
  2. Concentric sculpture obsolete upon the medial portion of the shell. *Lima serrata*

B. Posterior auricle obsolete, anterior auricle very large .... *Lima obliqua*

LIMA RETICULATA Forbes

Plate XXXIV, Figs. 12, 13

Lima reticulata Forbes, 1845, Quart. Jour. Geol. Soc., London, vol. i, p. 62; two text figures.

Lima reticulata Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 7.

Radula reticulata Conrad, 1868, Cook's Geol. of New Jersey, p. 725.

Radula reticulata Stoliczka, 1871, Mon. Geol. Survey of India, Palæont. Indica., Cret. Fauna Southern India, vol. iii, p. 416.

Etymology: *Lima,* a file—a name suggested, doubtless, by the rasping exterior surface.

Radula reticulata **Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 63, pl. ix, figs. 8, 9. (Synonymy excluded.)**

Lima reticulata **Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 492, pl. liv, figs. 3, 4.**

Description.—" L. testa ovata, obliqua, inflata, tenui, longitudinaliter sulcata, sulcis reticulatis, numerosis. Habitat, Nov. Jersey."—Forbes, 1845.

" Shell small, moderately oblique, strongly ovate, and inflated. Hinge short; beaks proportionally strong, and projecting beyond the cardinal line. Valves nearly equal; anterior margin straight, and not at all gaping; auriculations small but distinct, rectangular or very slightly pointed at their outer angles. Surface radiately ribbed, those of the anterior and posterior slopes faintly marked or obsolete, ribs (about thirty) distinct, with five or more indistinct on each side; subangular on the middle of the valves and rounded toward the sides, crenulate or subspinose on the larger specimens when well preserved, but often appearing nearly smooth. Entire surface marked by concentric lines which give a roughened surface when perfect, giving the reticulated character indicated by the specific name. The shells are all small, seldom exceeding three-fourths of an inch in length, and are very fragile. The right valve apears to be a little less ventricose and the beak shorter than the left in all the specimens which I have seen where the two are united."—Whitfield, 1885.

There is apparently a large amount of variation in this small species, and, as the type is not in this country, it is difficult to determine its proper limits. In Maryland the forms referred to this group are all young and of rather doubtful affinities, so that they throw no light upon the characters of the race. *Radula denticulicosta* Gabb is probably distinct if Gabb was correct in his observation that " at both the anterior and posterior sides the ribs disappear for about one-sixth the width of the shell."

Occurrence.—MONMOUTH FORMATION. Brightseat and McNeys Corners, Prince George's County.

Collections.—Maryland Geological Survey, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—Matawan Formation. Merchantville clay marl, Woodbury clay, Marshalltown clay marl, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, New Jersey. *Black Creek Formation.* North and South Carolina. *Peedee Sand.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Georgia; Russell County, Alabama. *Ripley Formation.* *Exogyra ponderosa* zone, Union Springs, Alabama; Booneville, Mississippi. *Exogyra costata* zone, Georgia; Eufaula, Alabama; east-central Mississippi; Alcorn, Union and Tippah counties, Mississippi. *Selma Chalk.* *Exogyra costata* zone, east-central Mississippi. *Extreme top of zone,* Pataula Creek, Georgia.

LIMA SERRATA n. sp.

Plate XXXIV, Figs. 14, 15

Description.—Shell small, moderately inflated, ovate in outline, inequilateral; anterior area obtusely angulated; posterior evenly rounded: base line arcuate, somewhat obliquely produced in front; umbones moderately gibbous orthogyrate, slightly posterior in position; external surface sculptured with thirty-two primary costæ (in the unique type the summits are acutely angulated and form with the more obtuse interradials a sharply serrate profile); radials upon the posterior portion less angular; the ten anterior costæ rounded, over-run and minutely nodulated by the incrementals; minute secondary threadlets developed in the interspaces on the posterior medial portion of the disk; posterior submargin devoid of radial sculpture; incremental sculpture obsolete over the medial portion of the shell and only feebly developed posteriorly; submargins not impressed, auricles minute, the anterior more so than the posterior, trigonal, their dorsal margins forming the straight hinge margin (unfortunately the posterior auricle was lost in shipment to the artist); ligament internal, lodged in a small but relatively very wide resilium directly beneath the umbones; hinge dentition not developed; shell monomyarian, the single muscle scar subcircular, placed above and behind the medial planes of the shell; pallial line indistinct; interior finely plicated even to the umbonal region in harmony with the external ribbing.

Dimensions.—Altitude 8 mm, latitude 7.75 mm., semi-diameter, 2 mm.

Type Locality.—Brightseat, Prince George's County.

This species differs from its near relative, *L. reticulata* Lyell and Forbes, in the somewhat smaller size, the much more angular costæ, the absence of any trace of concentric sculpture upon the medial portion of the disk and the development of occasional secondaries.

Occurrence.—MONMOUTH FORMATION. Brightseat and McNeys Corners, Prince George's County.

Collection.—Maryland Geological Survey.

LIMA OBLIQUA n. sp.

Plate XXXIV, Fig. 11

Description.—Shell of moderate size for the group, very thin and fragile, inequilateral, ovate in outline, obliquely produced along the diagonal from the umbones to the anterior ventral margin; posterior portion of the shell compressed and obtusely rounded at the junction of the dorsal lateral and the lateral ventral margins; maximum inflation in the umbonal region and along the dorsal half of the diagonal; umbones acute, obliquely compressed, somewhat posterior in position; posterior auricle obsolete, the anterior very large, fully one-third as wide as the entire shell, its submargin deeply impressed and sharply differentiated from the disk; external surface sculptured with some twenty-six low, flattened radial costæ which tend to diastomose posteriorly; intercalations occasionally developed near the ventral margin; intercostal areas shallow, not quite so wide as the costals, radial sculpture absent upon the auricle, excepting for two or three very faint threadlets upon the extreme posterior portion; concentric sculpture absent, excepting for very faint striations upon the disk; byssal sinus probably very shallow; characters of hinge and interior not known; ventral margin minutely crenated by the ribbing.

Dimensions.—Altitude 11 mm., latitude 8.5 mm., semi-diameter 2.5 mm.

This species is described from two imperfect specimens, but the characters preserved are so peculiar and so diagnostic that the form has

seemed worthy of a name. The species differs from the other East Coast forms in the obliquely produced and rather depressed outline, the low flattened posteriorly dichotomous riblets, the very large sharply differentiated anterior ear and the absence of the posterior auricle.

Occurrence.—MONMOUTH FORMATION. Brooks estate near Seat Pleasant, Prince George's County.

Collection.—Maryland Geological Survey.

Superfamily ANOMIACEA

Family ANOMIIDAE

Genus PARANOMIA Conrad

[Jour. Acad. Nat. Sci., Phila., vol. iv, 1860, p. 290]

Type.—*Placunanomia saffordi* Conrad.

"Inequivalve, irregular; larger valve radiate, spinous or subspinous; lower valve flat or concave; hinge very thin and fragile, having a longitudinal flat shelly plate extending from the apex; hinge of upper valve plain, entire, extremely thin. I have often found fragments of this singular genus in the New Jersey Cretaceous beds, but never saw the hinge before Mr. Safford's specimens were received from Tennessee. The muscular impression is not visible on any of the many valves I have seen." —Conrad, 1860.

"In 1867 Conrad described a genus *Paranomia,* from the Ripley group (Upper Cretaceous) of Alabama, to which he referred his *Placunanomia saffordi* (Journ. Acad. Nat. Sci., 2d ser., iv, p. 290, pl. 46, fig. 21) and the *Placuna scabra* of Morton. The typical species is ill preserved, and the beaks almost always wanting, but, from the examination of a large number of specimens, it seems probable that the genus resembles *Monia* in its external characters; the presence of a triangular chondrophore recalls *Anomia,* but there is not sufficient evidence of a permanent foramen, the musclar impressions are not preserved, and there is in the right valve, associated with the single chondrophore, a pair of low, narrow crests, recalling

Etymology: παρά near, *anomia.*

those of *Placenta,* but obviously of different function. The genus is a puzzle and cannot as yet be safely united with any other."—Dall,[1] 1898.

A. Outline circular; radials relatively fine and crowded....*Paranomia scabra*
B. Outline ovate; radials relatively coarse and distant.....*Paranomia lineata*

PARANOMIA SCABRA (Morton) Conrad

Placuna scabra Morton, 1834, Syn. Org. Rem. Cret. Group U. S., p. 62.
Placunomia scabra Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 6.
Paranomia scabra Conrad, 1867, Am. Jour. Conch., vol. iii, p. 8.
Paranomia scabra Conrad, 1868, Cook's Geol. of New Jersey, p. 724.
Paranomia scabra Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 44, pl. x, fig. 10.
Paranomia scabra Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 12.
Paranomia scabra Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 500, pl. iii, figs. 10-13 (*ex parte*).

Description.—"With numerous beaded costæ, radiating from the hinge to the margin; shell thin, suborbicular, compressed. From one inch to three inches in diameter."—Morton, 1834.

Type Locality.—New Jersey.

The type specimen figured by Whitfield in 1885 is a mere fragment which, as that eminent New Jersey paleontologist has observed, is "scarcely sufficient for generic identification." However, its reference to *Paranomia* is probably justified. The species as delimited by the aid of later collections is thin, flattened and subcircular in outline, sculptured externally with approximately thirty rather fine radials which occasionally diastomose and which are quite sharply spinose toward the ventral margin. The intercostal areas are narrow, scarcely or not at all exceeding the costals in width. The incremental sculpture is quite vigorous and sufficient to imbricate the radial.

Paranomia saffordi Conrad from Tennessee and the type of the genus develop apparently a much more regular and rather coarser and more distant radial sculpture. *Paranomia lineata* Conrad runs smaller, is ovate rather than subcircular and has fewer, more prominent and more widely spaced radials. Although it is not impossible that a connecting series may

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. iv, p. 773.

later be established which will include either or both *P. saffordi* and *P. lineata,* there does not seem at present to be sufficient evidence.

Occurrence.—MATAWAN FORMATION. Opposite Post 198, Chesapeake and Delaware Canal, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, Marshalltown clay marl, New Jersey. *Peedee Sand.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, Alcorn County, Mississippi. *Ripley Formation. Exogyra costata* zone, Georgia; Eufaula, Alabama; east-central Mississippi; Pontotoc County, Mississippi. *Selma Chalk. Exogyra ponderosa* zone, Warrior River, Alabama; Monroe and Chickasaw counties, Mississippi. *Exogyra costata* zone, Tombigbee River and Sumter County, Alabama; east-central Mississippi; Chickasaw, Pontotoc and Alcorn counties, Mississippi.

PARANOMIA LINEATA Conrad

Plate XXXV, Figs. 11, 12

Placunanomia lineata Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2 ser., vol. iv, p. 291, pl. xlvi, fig. 20.

Placunomia lineata Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 6.

Paranomia lineata Conrad, 1867, Am. Jour. Conch., vol. iii, p. 8.

Paranomia lineata Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 45, pl. ix, fig. 10.

Paranomia lineata Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 12.

Paranomia scabra Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 500, pl. lii, figs. 10-13 *(ex parte)*.

Description.—" Subovate, thin, much compressed, irregular; lower valve concave, obsoletely radiate; near the summit is a resemblance to a triangular plate inserted in the shell with a raised margin; this portion is longitudinally minutely striate and resembles one of the opercular valves of a *Balanus;* upper valve convex, lobed or twisted; radiated with about thirty rugose, slightly raised, subaculeated lines; surface rugose."—Conrad, 1860.

Type Locality.—Tennessee.

Paranomia lineata Conrad is separated from *P. scabra* (Morton) Conrad by the regularly ovate outline and its coarser, more prominent and more distant radials. All of the specimens observed have been a little smaller than the adult *P. scabra,* but this may have been due only to the fortunes of collecting.

Occurrence.—MATAWAN FORMATION. One mile east of the Maryland-Delaware Line, Chesapeake and Delaware Canal, Delaware.

Collections. Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Monmouth Formation.* Navesink marl, New Jersey. *? Ripley Formation.* Tennessee.

Genus ANOMIA (Linné) Müller
[Prodr. Zool. Dan., 1776, pp. xxxi, 248]

Type.—*Anomia ephippium* Linné.

Shell inequivalve, adherent, generally subcircular or oblong; left valve more or less convex, right valve flattened; hinge margin of left valve often incurved and slightly thickened; ligament scar found directly beneath left umbone; interior of disk of left valve scarred with an adductor and a major and minor byssal impression, the major byssal scar being the largest of the three and dorsal to the adductor and minor byssal scars which are usually subequal; interior of right valve containing foraminal opening and, ventral to it, the impression of the adductor muscle; posterior dorsal margin of right valve carrying inconspicuous ligamental process; pallial line simple.

"The fossil species of this group are very difficult things to study, since the lower valve is seldom preserved and the muscular impressions can seldom be made out. . . . To the natural difficulties is added that due to the fact that the sculpture in this genus is very variable in perfectly normal specimens and is further complicated by the differences of form and surface, due to the object upon which they are sessile. I have satisfied myself by the examination of a large number of recent specimens belonging to a single species from a single locality that the relative positions of the

Etymology: ἀνόμοιος unequal, unlike.

adductor and byssal scars of the left valve are not constant in the same individual at all ages, and consequently that small differences of this kind cannot safely be used as specific distinctions. The best character seems to be the more minute surface sculpture when fully developed in normal specimens."—Dall, 1898.[1]

Ancestral forms of this genus have been recognized in rocks as ancient as the Devonian. The recent species number about forty and are widely ditributed along the shores from low-water to one hundred fathoms.

A. External surface not radially plicate.
 1. Outline sub-circular; concentric lamination, very close excepting in the umbonal region .... *Anomia argentaria*
 2. Outline transversely ovate; concentric lamination rather distant. *Anomia tellinoides*

B. External surface radially plicate.
 1. Radial sculpture, lirate rather than cordate, primaries and secondaries not conspicuously differentiated .... *Anomia ornata*
 2. Radial sculpture cordate rather than lirate; primaries and secondaries conspicuously differentiated .... *Anomia forteplicata*

ANOMIA ARGENTARIA Morton

Plate XXXV, Figs. 1, 2

Anomia argentaria Morton, 1833, Am. Jour. Sci., 1st ser., vol. xxiii, p. 293, pl. v, fig. 10.

Anomia argentaria Morton, 1834, Syn. Org. Rem. Cret. Group, U. S., p. 61, pl. v, fig. 10.

Anomia argentaria Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 6.

Anomia argentaria Conrad, 1868, Cook's Geol. Survey of New Jersey, p. 724.

Anomia argentaria Conrad, 1875, Kerr's Geol. of North Carolina, Appendix A, p. 13.

Anomia argentaria Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 319.

Anomia argentaria Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 42, pl. iv, figs. 10, 11 (fig. 9 excluded).

Anomia argentaria Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 12.

? *Anomia argentaria* Böse, 1906, Bol. Inst. Geol. Mexico, No. 24, p. 38, pl. i, fig. 8.

Anomia argentaria Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 496, pl. liv, figs. 11-15.

? "*Anomia subtruncata*" Böse, 1913, Bol. Inst. Geol. Mexico, No. 30, p. 41, pl. v, fig. 1.

Description.—"Thin, round, with numerous concentric striæ."—Morton, 1833.

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. iv, p. 781.

Type Locality.—New Jersey.

Shell subcircular or irregular in outline with a silvery sheen both within and without, thin but tough, of moderate size, the adults from 15 to 30 mm. in circumference; left valve usually convex, though varying widely in the degree of convexity; right valve, through which the byssus is extruded, flattened; umbones central, almost marginal, very inconspicuous, scarcely interrupting the regular outline of the valve; external surface ornamented with thin, concentric overlapping lamellæ which are frequently radially lineated; ligament submarginal, attached beneath the umbo of the left valve; hinge edentulous; interior scarred with a large, major byssal impression, medial in position and quite high up under the umbones and ventral to it, the minor byssal impression, and the posterior muscle adductor; a third byssal scar of minute size underneath the dorsal margin, a little in front of the umbones; inner ventral margins simple.

This species is one of the most abundant bivalves in the Upper Cretaceous faunas of Maryland. For all the shell is so thin, it is very tenacious and easily separable from the matrix. It is an unusually well characterized species and even the fragments can be determined with assurance by the silvery sheen, the crowded concentric laminæ and in the majority of individuals by the fine, radial lineation.

The form varies to a certain extent, as do all members of this variable genus, in the outline, the degree of compression of the valves, and particularly in the development of the radial sculpture. However, limits must be placed even for variable species and it is not probable that they should be made wide enough to include *A. tellinoides* Conrad, which is constant in its transversely ovate outline, lack of lustre, rather distant concentric lamination and absence of radial striations.

Some puzzling little forms from the Monmouth at Brightseat are closely related genetically with the *A. argentaria* Morton. They are apparently young, frequently ovate, rather thin, circular in outline and are sculptured with a few wide, sharp-edged concentric frills which are often radially lineated. Concentric laminæ so distantly spaced and so sharply frilled have not been observed among the *A. argentaria.*

Occurrence.—MATAWAN FORMATION. Post 198, Chesapeake and Delaware Canal, Delaware; head of Magothy River, Gibson's Island, Anne Arundel County, Maryland. MONMOUTH FORMATION. Two miles west of Delaware City on John Higgins farm, Delaware; mouth of Turner's Creek, Kent County; Brightseat, railroad cut west of Seat Pleasant, Brooks estate near Seat Pleasant, Friendly, and 1 mile west of Friendly, Prince George's County, Maryland. RANCOCAS FORMATION (?). Noxontown Pond, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Magothy Formation.* Cliffwood clay, New Jersey. *Matawan Formation.* Merchantville clay marl, Woodbury clay, Marshalltown clay marl and Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl and Red Bank sand, New Jersey. *Black Creek Formation.* North and South Carolina. *Peedee Sand.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Georgia; Russell and Dallas counties, Alabama; Tombigbee River, Clay County, Mississippi. *Exogyra ponderosa* zone, Alcorn County, Mississippi; Georgia; Union Springs and Russell County, Alabama. *Exogyra costata* zone, Georgia; Chattahoochee River and Eufaula, Alabama; east-central Mississippi; Lee, Pontotoc, Chickasaw, Union and Tippah counties, Mississippi. *Selma Chalk. Exogyra ponderosa* zone, Elmore County, Alabama; Clay, Monroe, Alcorn and ? Prentiss counties, Mississippi. *Exogyra costata* zone, Wilcox and Sumter counties, Alabama; east-central Mississippi; Chickasaw, Lee, Clay, Alcorn and Prentiss counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Lowndes County, Mississippi. *Senonian.* Mexico.

ANOMIA TELLINOIDES Morton

Plate XXXV, Figs. 3, 4

Anomia tellinoides Morton, 1833, Am. Jour. Sci., 1st ser., vol. xxiii, p. 294, pl. v. fig. 10.

Anomia tellinoides Morton, 1834, Syn. Org. Rem. Cret. Group, U. S., p. 61, pl. v, fig. 11.

Anomia tellinoides Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Cret. and Jur., p. 7.
Anomia tellinoides Conrad, 1868, Cook's Geol. of New Jersey, p. 724.
Anomia tellinoides Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 43.
Anomia tellinoides Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 12.
Anomia argentaria Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 496 (*ex parte*, description and figures excluded).

Description.—"Irregular, but mostly subovate, with concentric undulations. Both these species are common in New Jersey; the latter resembles *A. ephippium,* to which it is referred in the first part of this Synopsis."—Morton, 1833.

Type Locality.—New Jersey.

Shell rather thin but tenacious, inequilateral, transversely ellipsoidal in outline, the lower valve moderately convex; anterior portion of the shell constricted in front of the umbones; anterior margin broadly and evenly rounded; posterior portion of shell symmetrical, rounded; base arcuate; umbones low, not very conspicuous, with ill-defined apices placed as a rule a little behind the median line; external surface sculptured with an indistinct and rather distant concentric lamination; ligament submarginal attached beneath the umbo of the left valve; hinge plate not developed, edentulous; pedal and byssal scars indistinct.

This species has been confused in the synonymies with *A. argentaria.* The forms are certainly closely related but there is not sufficient evidence of their identity. *A. tellinoides* is transversely ovate in outline, rather than subcircular, the surface is less silvery, the concentric lamination less crowded and the radial striations much less commonly developed than in the more prolific *A. argentaria.*

Occurrence.—MONMOUTH FORMATION. Briar Point, Chesapeake and Delaware Canal, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Monmouth Formation.* Navesink marl, New Jersey.

ANOMIA ORNATA Gabb

Plate XXXV, Figs. 5, 6

Anomia argentaria var. ornata **Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 320.**

"*Anomia argentaria* (Gabb)" Boyle, 1893, Bull. U. S. Geol. Survey, No. 102, p. 44.

Description.—" Accompanying these is another form, represented by no less than fifteen specimens agreeing well with one another. Unlike the typical *A. argentaria,* they are ornamented by a uniform pattern, clearly not the impression of a surface to which they were attached. In form and size they do not differ from *A. argentaria,* but the ornament is a series of radiating ribs, one set large, flattened on top, and well defined; between these are interpolated from one to three smaller ribs. In most cases this alternation is well defined; though in two or three the large ribs are nearer in size to the small ones. On the typical *argentaria* this radiation is never observed, even in a rudimentary manner, and on some of my specimens it begins at the very apex; but on several the first half inch in diameter, or less, of the shell does not differ from *argentaria,* while after that the ribs begin, first on thread-like lines, finally developing to full size. In consequence of this I feel reluctant to separate the form as a distinct species, believing that more material will merge the two. I therefore content myself with proposing the name *A. argentaria* var. *ornata*."—Gabb, 1876.

Type Locality.—Pataula Creek, Georgia.

Ligament submarginal, lodged in a transverse pit directly beneath the umbone of the left valve; adductor and byssal scars grouped within an ovate area coated with lime extending from the ligament pit more than half-way to the ventral margin and occupying more than one-half the width of the shell, major byssal scar near the center of the whitish area, slightly ovate in outline; minor byssal scar and adductor ventral to the major cicatrix, subequal in size, semi-elliptical, their straight faces proximate, the adductor the posterior of the two; major and minor scars united for a short distance along the dorsal face of the latter.

Although most of the individuals which are certainly referable to *A. argentaria* Conrad develop a faint radial lineation, none in the abund-

ant material from the Monmouth of Maryland bridge the gap between that race of *argentaria* and the costate *ornata* of Gabb. In fact the distance is greater between Conrad's species and Gabb's than between Gabb's and the *A. forteplicata* n. sp. *A. ornata* has, however, much more of the laminar *argentaria* texture, a finer and less differentiated radial sculpture and a relatively stronger concentric sculpture than *A. forteplicata.*

Occurrence.—MONMOUTH FORMATION. Brightseat and McNeys Corners, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Outside Distribution.—Ripley Formation. Exogyra costata zone. *Extreme top of zone,* Pataula Creek, Georgia.

ANOMIA FORTEPLICATA n. sp.

Plate XXXV, Figs. 7-10

Description.—Shell nacreous, moderately large, rudely circular, subcircular or irregular in outline; umbones inconspicuous, submarginal, medial in position, apices obtuse; external surface sculptured with fifteen to forty cordate primary radials and between each pair of primaries one to five secondary lirations of more or less unequal strength; incremental sculpture over-riding the radial but not modifying it to any degree; ligament submarginal, attached beneath the umbone in the left valve; hinge armature not developed; adductor and byssal scars grouped within an area thinly coated with lime, occupying the medial dorsal half of the shell; scars brownish in color, three in number, the largest of the three the major byssal scar, minor byssal scar and adductor impression being subequal and ventral to the major cicatrix; ventral margin sharply crenate in harmony with the external ribbing, the plications reflected on the interior of the shell in some individuals almost to the umbones; characters of right valve not known.

Dimensions.

Altitude 24 mm., latitude 24.5 mm., semi-diameter 6.6 mm.
Altitude 23 mm., latitude 17.5 mm., semi-diameter 7.5 mm.
Altitude 12.7 mm., latitude 14.5 mm., semi-diameter 3.5 mm.

Although the representatives of this species differ so widely in general aspect, still there seems to be no reason to consider these differences as more than individual mutations of a variable species in a variable genus. The ratio between the number of costals and their prominence is very constant, those individuals in which the primaries are few in number being very heavily sculptured.

Anomia forteplicata is a more solid shell than *A. ornata* Gabb, with a much more vigorous radial sculpture and a relatively more feeble concentric.

Occurrence.—MONMOUTH FORMATION. Brightseat, 1 mile west of Friendly, McNeys Corners, Prince George's County.

Collection.—Maryland Geological Survey.

D. Dysodonta

Superfamily MYTILACEA

Family MYTILIDAE

Genus MODIOLUS Lamarck

[Prodr. Nouv. Class. Coq., 1799, p. 87]

Type.—*Mytilus modiolus* Linné.

Shell equivalve, inequilateral, transversely or obliquely ovate in outline; ligament external, opisthodetic; hinge edentulous; anterior muscle impression atrophied; pallial line simple.

The genus is separated from *Mytilus* by the character of the beaks which are non-terminal, wider and rounded anteriorly. It has a long geologic range, at least from the beginning of the Mesozoic and possibly from the Devonian. The recent species are about seventy in number and are most abundant in the tropical seas. Unlike *Mytilus,* the representatives of *Modiolus* are nest-builders and burrow or spin a woven structure from stones and fragments of shells.

A. Latitude of adult shell exceeding 20 mm.
  1. Shell obtusely angulated at the posterior dorsal extremity. *Modiolus burlingtonensis*
  2. Shell smoothly rounded at the posterior dorsal extremity. *Modiolus sedesclarus*

B. Latitude of adult shell not exceeding 20 mm............. *Modiolus trigona*

Etymology: *Modiolus*, small drinking vase.

MODIOLUS BURLINGTONENSIS Whitfield

Modiolus burlingtonensis Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 65, pl. xvii, figs. 8, 9.
Modiolus burlingtonensis Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 12.
Modiolus burlingtonensis Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 505, pl. lv, figs. 18, 19.

Description.—" Shell of moderately large size, very ventricose, and with subparallel dorsal and ventral margins, large prominent umbones and incurved beaks situated near the anterior end but not terminal, the anterior margin perceptibly extending beyond them and rounded. Umbonal ridge prominent and subangular, especially near the beaks, and becoming broader and more rounded posteriorly; surface of the valves strongly constricted and sinuate in front of the ridge and the anterior surface again inflated; cardinal slope comparatively broad and slightly concave toward the postero-cardinal border. Hinge line straight and three-fifths as long as the shell, and rather strongly impressed in the internal cast; postero-cardinal margin rounding rapidly forward from the more narrowly rounded posterior extremity. Surface of the cast, the only condition under which it is known, apparently smooth or marked only by irregular concentric lines of growth, some of which produce undulations of considerable strength on the casts. On one individual there appear on the posterior cardinal slope very faint indications of rather coarse radiating lines, but too faint to warrant the statement that such markings really existed on the shell."—Whitfield, 1885.

Type Locality.—Burlington County, New Jersey.

The species is much the largest of any of the Matawan *Modioli,* and is represented in Maryland by only a couple of imperfect casts.

Occurrence.—MATAWAN FORMATION. Camp U & I, opposite Post 192, Chesapeake and Delaware Canal, Delaware.

Collection.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, New Jersey.

MODIOLUS TRIGONUS n. sp.

Plate XXXVI, Fig. 3

Description.—Shell thin, nacreous, equivalve, strongly inequilateral, transversely elongate, suggesting a right triangle in outline, the anterior margin constituting the shorter leg, the base line the longer, and the posterior keel the hypothenuse; umbones prominent, acute, prosogyrate, subterminal in position; anterior margin squarely truncate in front of the umbones; posterior dorsal and lateral margins gently rounded, merging into one another; base line horizontal; posterior keel obtuse, persistent from the umbones to the posterior ventral margin; area behind it approximately half as great as that in front of it; external surface smooth and lustrous, excepting for feeble incremental striations.

Dimensions.—Altitude 8.5 mm., latitude 14.5 mm., maximum diameter 9 mm.

The species is described from a cast of a complete individual, to one side of which the shell substance still adheres. The angular outline is peculiarly characteristic and nothing approaching it has been observed elsewhere.

Occurrence.—MONMOUTH FORMATION. Brooks estate near Seat Pleasant, Prince George's County.

Collection.—Maryland Geological Survey.

MODIOLUS SEDESCLARUS n. sp.

Plate XXXVI, Figs. 1, 2

Description.—Shell nacreous in texture, exceedingly thin and fragile, transversely elongate, slightly wider posteriorly; umbones inflated, prosogyrate, almost but not quite terminal in position; anterior end obscurely truncate; dorsal margin slightly more elevated posteriorly; posterior extremity obliquely rounded, the dorsal margin merging smoothly into the lateral; ventral margin straight, not constricted medially; umbonal ridge very prominent but evenly rounded, becoming broader and lower toward the posterior ventral margin; external surface

smooth, excepting for the sharply laminar incremental ridges developed near the dorsal and anterior margins and the prominent growth lines near the ventral margins; characters of interior not known.

Dimensions.—Altitude 10 mm., latitude 22 mm., maximum diameter 7 mm.

This species is smaller than *M. burlingtonensis* Whitfield, not constricted along the medial ventral margin, and more smoothly rounded behind.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collection.—Maryland Geological Survey.

Genus LITHOPHAGA Bolten

[Museum Boltenianum, 1788, p. 156]

Type.—*Mytilus lithophagus* Linné.

Shell thin, nacreous, equivalve, strongly inequilateral, transversely elongated, more or less cylindrical in outline; umbones strongly anterior, but not terminal; anterior extremity rounded; posterior extremity rostrate or cuneiform; external surface smooth or feebly sculptured concentrically; ligament submarginal; hinge edentulous; muscle impressions unequal, indistinct.

The genus has been reported from strata as far back as the Carboniferous. The recent species number less than fifty, and are confined to the tropical and subtropical waters.

The young are attached by a byssus, but in the later stages usually perforate coral colonies, the shells of larger bivalves or even the solid rock. Two of the five subgenera into which the group has been divided are encrusted with a dense calcareous covering in the adult stages. The cavities which they excavate are characteristically flask-shaped in outline. The perforations in the columns of the temple of Serapis which served Lyell for his classic illustration of changes in the level of the sea were made by Lithophagæ.

Etymology: λίθος, stone; φαγεῖν, to eat.

A. Shell encrusted with concentrically laminated calcareous covering. *Lithophaga ripleyana*
B. Shell not encrusted.
  1. Latitude of adult shell not exceeding 18 mm.
    a. Outline subcylindrical.
      i. Shell occurring in hard substances especially in the tests of larger bivalves............*Lithophaga conchafodentis*
      ii. Shell occurring free or in clay tubes......*Lithophaga juliæ*
    b. Outline transversely ovate..................*Lithophaga lingua*
  2. Latitude of adult shell exceeding 18 mm.; outline subcylindrical. *Lithophaga twitchelli*

LITHOPHAGA RIPLEYANA Gabb

Plate XXXVI, Figs. 4-6

Lithophaga ripleyanus Gabb, 1862, Proc. Acad. Nat. Sci., Phila. for 1861, p. 326.

Lithophaga ripleyanus Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 10.

Lithophaga ripleyana Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 311.

Lithodomus ripleyana Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 67, pl. xvii, figs. 4, 5 *(ex parte)*.

Lithophaga ripleyana Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 13.

Lithophaga ripleyana Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 512, pl. lvi, figs. 9-12 *(ex parte)*.

Description.—" Tube subcylindrical, nearly straight, gradually tapering, broadest on the dorsal surface; opposite face narrow, rounded; extremity abrupt, rounded and faintly subtrilobate. Shell subquadrate. Beaks terminal, and projecting beyond the buccal end of the shell, very much incurved, so as to appear somewhat spiral. Umbones broad, slightly flattened in the middle. Cardinal margin straight anteriorly, depressed posteriorly, merging into the anal border, which is subtruncate and most prominent above. Basal edge broadly emarginate. Surface marked by numerous, irregular, concentric lines."—Gabb, 1860.

Type Locality.—Big Timber Creek, between Gloucester and Red Bank, New Jersey.

Form gregarious, rudely cylindrical, constricted mesially; protective covering built up of thin, concentric layers of calcite, usually conforming rather closely to the outline of the shell; shell itself very thin, nacreous in texture; umbones terminal, prosogyrate, well rounded at their tips; anterior portion inflated, truncate; shell, in the majority of the indi-

viduals, feebly depressed in front of the obscure carina which extends from the umbones toward the posterior ventral margin, the depression being reflected in the slight concavity of the base; posterior end strongly and symmetrically arcuate; dorsal margin approximately horizontal; external surface smooth excepting for the incremental sculpture which is rather conspicuous, particularly in the posterior portion of the shell; characters of interior not known.

The species frequently occurs in clusters, the individuals being attached at the posterior extremity. The degree of medial constriction is not constant.

L. ripleyana Gabb is relatively more elongated transversely than *L. affinis* Gabb, a co-existent species over much of the area of its occurrence, and is much less inflated.

Occurrence.—MATAWAN FORMATION. Opposite Post 239, Post 236, Camp Fox, Chesapeake and Delaware Canal, Delaware. MONMOUTH FORMATION. Bohemia Mills, Cecil County; Brightseat, Brooks estate near Seat Pleasant, Friendly, Prince George's County, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, New Jersey. *Ripley Formation.* *Exogyra costata* zone, Union County, Mississippi.

LITHOPHAGA CONCHAFODENTIS n. sp.

Plate XXXVI, Figs. 7-9

Description.—Shell nacreous in texture, moderately large for the genus, subcylindrical to rectangular in outline, exceedingly thin and fragile; umbones nearly terminal, small, full but angular, flattened upon their summits, acute, prosogyrate; posterior area cut off by a carina which persists from the umbones to the posterior basal margin, acute near the umbones, but evanescing toward the base; anterior end very short and obscurely truncate; posterior end much produced, strongly rounded at its extremity; the dorsal and ventral margins rudely parallel, the dorsal

41

slightly convex, the ventral broadly and feebly constricted; external surface smooth excepting for a rather vigorous incremental sculpture; ligament submarginal, opisthodetic; hinge edentulous; adductor scars and pallial characters obscure.

Dimensions.—Altitude 5 ± mm., latitude 13 ± mm., semi-diameter 3.5 ± mm.

The remains of this small borer are found in the tests of *Exogyra* and *Pycnodonte*. It differs from *L. ripleyana,* which it most strongly resembles, not only in its habitat but also in the less inflated valves and less produced posterior extremity.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collection.—Maryland Geological Survey.

LITHOPHAGA JULIÆ (Lea)

Plate XXXVI, Figs. 10, 11

Modiola Juliæ Lea, 1862, Proc. Acad. Nat. Sci., Phila. for 1861, p. 149.
Modiolus Juliæ Meek, 1864, Check List. Inv. Fossils N. A., Cret. and Jur., p. 11.
Perna Juliæ Conrad, 1868, Cook's Geol. of New Jersey, p. 726.
Modiola Julia Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 64, pl. xvii, fig. 6 (not fig. 7).
Modiolus Julia Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 12.
Modiolus Juliæ Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 506 (*ex parte*, description and figures excluded).

Description.—"Testa transverse striata, subrhomboidea, subinflata, postice oblique truncata, inferne emarginata; valvulis fragillissimis; natibus prominulis, fere terminalibus. Length .23, breadth .36 of an inch." —Lea, 1862.

Type Locality.—Haddonfield, New Jersey.

Shell nacreous, excedingly thin and friable; transversely ovate in outline, compressed; umbones placed within the anterior seventh of the shell, not prominent but evenly rounded, proximate, incurved and slightly prosogyrate; anterior end of shell feebly expanding in front of the beaks; posterior dorsal margin approximately horizontal; posterior lateral mar-

gin quite strongly rounded, obliquely produced at the base; ventral margin somewhat oblique to the dorsal; posteriorly produced, in many individuals feebly and broadly contracted medially; basal constriction due to the broad and very shallow depression of the valves in front of the obtuse posterior carina which is initiated at the umbones and most prominent at its origin, becoming feebler and finally evanescing about half-way to the posterior ventral margin; external surface sculptured with sharp, rather distant and irregularly spaced incremental lirations which tend to become obsolete upon the medial portion of the shell; characters of interior of shell not known.

Casts of this small form are not rare in the Upper Cretaceous of Maryland, although the shell is so thin and so flaky that it has not been found possible to secure any fragments large enough to give the hinge dentition, yet the exceedingly thin and very highly nacreous shell and its general outline suggest *Lithophaga* rather than *Modiolus*. The form is much more compressed than *L. ripleyana* Gabb, the umbones more flattened and the posterior carina more angular. Furthermore there is no evidence that a calcareous encrustation was ever developed as in the Ripley species, but rather that it buried itself in the soft muds near the shore.

Whitfield's restoration of Gabb's type is probably inaccurate as the material is much crushed and the original outline obscure.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, and Woodbury clay, New Jersey.

LITHOPHAGA LINGUA n. sp.

Plate XXXVI, Fig. 14

Description.—Shell small, compressed, not very thin, transversely and somewhat obliquely ovate in outline; umbones anterior, almost but not quite terminal, well rounded, but not conspicuously inflated, proximate,

incurved, prosogyrate; valves flattening in all directions away from the umbones; anterior end very short, rounded; posterior end obliquely produced along the obscurely elevated diagonal from the umbones to the posterior ventral margin; posterior dorsal and lateral areas relatively very wide, their margins forming a somewhat asymmetrical arc connecting the umbones and the base; ventral margin slightly oblique with a feeble suggestion of a mesial constriction; faint concentric sculpture probably developed on external surface; characters of hinge and interior not known.

Dimensions.—Maximum altitude 5 mm., maximum latitude 8 mm., maximum diameter 3.5 mm.

This small but apparently adult *Lithophaga* is separated from the co-existent members of the same genus not only by its slight dimensions but even more readily by the very short anterior end and expanded posterior end. In no other species is the area behind the diagonal relatively so wide or so flaring. The peculiar alate aspect thus produced is not repeated in any of the co-existent species. The form is described from a cast of double valves. The type is not unique, but the species has not been observed from any but the type locality.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collection.—Maryland Geological Survey.

LITHOPHAGA TWITCHELLI n. sp.

Plate XXXVI, Figs. 12, 13

Description.—Shell nacreous, apparently rather thick, large for the genus, subcylindrical in outline; umbones inflated, incurved, prosogyrate, proximate, placed within the anterior tenth; shell inflated along the diagonal from the umbones to posterior ventral margin, broadly and shallowly depressed between this obscure carina and the feebly inflated anterior end; anterior lateral margin obscurely truncate, posterior strongly arcuate; dorsal margin very feebly convex; base line somewhat constricted medially; external surface probably smooth; characters of interior of shell not known.

Dimensions.—Altitude 11.8 mm., latitude 21.8 mm., diameter of double valves 11.7 mm.

Lithophaga twitchelli suggests, at first, a giant *L. ripleyana* Gabb. However, *L. twitchelli* is not only a third as large again as Gabb's species, but, furthermore, the valves are very much more inflated, particularly along the diagonal; the umbones feebler and the medial depression more pronounced. Then, too, the shell is much heavier, apparently, and there is no evidence of the former presence of an encrustation.

This species is named for its collector, Dr. Mayville W. Twitchell, Assistant State Geologist of New Jersey.

The form is described from a cast of the double valves of a single individual to which a considerable amount of shell substance still adheres, although the external surface has been entirely decorticated.

Occurrence.—MONMOUTH FORMATION. Railroad cut west of Seat Pleasant, Prince George's County.

Collection.—Maryland Geological Survey.

Genus CRENELLA Brown

[Ill. Conch. Gr. Brit., 1827, pl. xxxi, figs. 12-14; 2d ed., 1844, p. 75, pl. xxiii, figs. 12-14. Not *Crenella* Sowerby]

Type.—*Mytilus decussatus* Laskey.

" Shell oblong-oval, equilateral, ventricose; beaks obtuse, slightly turned to one side; hinge destitute of teeth but with a flattened, horizontal, slightly crenated plate on one side of the hinge in each valve; right valve with a triangular, horizontal, projecting, reflexed plate, and the left one with an oblique plate, both of which are a little crenated externally."—Brown, 1844.

" This interesting little group extends through the Tertiary and, owing to the little study given to its characters, has received many names. The shell is usually convex and ovoid, with more or less incurved beaks, a nacreous inner layer, thin epidermis which adheres closely to the shell, and a fine radial, often crossed by a concentric striation. In young shells the provinculum is exceptionally well developed, sometimes recalling the

Etymology: Diminutive of *crena*, notch.

hinge of *Nucula* by its strong and projecting denticulations. If the shell is thin, these become obsolete with growth, but in some species are replaced by a series of denticulations directly consequent on the impingement of the external sculpture on the cardinal margin, thus repeating a second time in the same individual the process by which the provinculum was originally initiated in its ancestors. At least that is the way in which the writer interprets the facts. When the shell is thick, or when the external sculpture is very delicate, no secondary denticulations appear in the adult, which is then left with a practically unarmed hinge line. The appearance of the provinculum is not dependent on the existence of the external sculpture, but the secondary denticulations are so dependent. The exterior may be almost perfectly smooth and polished with only microscopic striation; finely radially striate without decussation (like *C. serica*), decussate, or with the radial sculpture strong and divaricate. Usually the sculpture is uniformly distributed over the surface, but occasionally there will be an area of unstriated separating two of striated surface, as in *Modiolaria*, but without the impressed boundaries of the latter genus."—Dall, 1898.[1]

This genus ranges from the Cretaceous to the Recent.

A. Adult shell not exceeding 6 mm. in altitude................*Crenella serica*
B. Adult shell exceeding 6 mm. in altitude...............*Crenella elegantula*

CRENELLA SERICA Conrad

Plate XXXVI, Figs. 16-18

Crenella (Stalagmium) serica Con., 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 281, pl. xlvi, fig. 23.
Crenella (Stalagmium) sericea Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 11.
Crenella serica Weller, 1907, Geol. Survey New Jersey, Pal., vol. iv, p. 510, pl. lvi, figs. 7, 8.

Description.—"Longitudinally oblong-ovate, very ventricose, finely striated concentrically and with microscopic, closely arranged, radiating lines; summit very prominent. Locality: Eufaula, Barbour County, Alabama."—Conrad, 1860.

[1] Dall, W. H., Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. iv, p. 802.

Shell very small and gibbous, between three and four millimeters in altitude, the interior regularly ovate in outline; umbones inflated, strongly prosogyrate and incurved, proximate; external surface sculptured with prominent and regularly spaced incrementals and resting stages; radial sculpture microscopically fine, not over-riding the concentric; ligament lodged in a narrow groove running backward from beneath the apices of the umbones; inner margins strongly crenulate, the area directly beneath the umbones slightly flattened and broadened and bearing four or five pseudo-taxodont denticles; a more extended, but less clearly defined, area developed in some individuals upon the medial portion of the posterior lateral margin; muscle scars and pallial lines indistinct. *Crenella serica* Con. is a very abundant little bivalve in the Monmouth of Prince George's County.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly, Prince George's County.

Collections.—Maryland Geological Survey, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—Matawan Formation. Marshalltown clay marl, New Jersey. *Monmouth Formation.* Red Bank sand, New Jersey. *Peedee Sand.* North and South Carolina. *Ripley Formation. Exogyra costata* zone, Georgia; Eufaula, Alabama. *Selma Chalk. Exogyra costata* zone, Tombigbee River, Sumter County, Alabama; east-central Mississippi; Alcorn, Union and Tippah counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Lowndes County, Mississippi.

CRENELLA ELEGANTULA Meek and Hayden

Plate XXXVI, Fig. 19

Crenella elegantula Meek and Hayden, 1862, Proc. Acad. Nat. Sci., Phila., for 1861, p. 441.

Crenella elegantula Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 11.

Crenella elegantula Meek, 1876, Rept. U. S. Geol. Survey, Territories, vol. ix, p. 75, pl. xxviii, figs. 6a-6c.

Crenella elegantula Weller, 1907, Geol. Survey New Jersey, Pal., vol. iv, p. 511, pl. lvi, fig. 6.

Description.—"Shell small, very thin and pearly, obliquely ovato-cordate, ventricose; postero-basal and basal margins rounded; dorsal border sloping posteriorly with an arcuate outline, and rounding into the anal margin behind; anterior border rounding obliquely backwards into the base; umbonal region of both valves very gibbous, beaks prominent, terminal, pointed, distinctly incurved and directed obliquely forward at the extremities; hinge margin smooth; free border minutely crenulated. Surface (as seen by aid of a magnifier) beautifully ornamented by extremely fine, regular, closely-arranged, radiating striæ, which increase chiefly by bifurcation, and continue of uniform size on all parts of the shell; crossing these are numerous, equally fine, but much less distinct, concentric lines, and occasional stronger marks of growth. Length, measuring obliquely forward and upward from the base to the beaks, 0.55 in.; diameter, from base to hinge, measuring at right angles to the greatest length, 0.4 inch; convexity, 0.37 inch. This beautiful little shell is very closely allied to *C. sericea* of Conrad, but differs in being uniformly more broadly ovate in form, and in having less elevated and less distinctly incurved beaks, while its concentric markings are not near so strongly defined."—Meek and Hayden, 1862.

Type Locality.—Deer Creek, near North Branch of the Platte River, Nebraska.

The species is recognized in Maryland from casts only. It is more than double the size of *C. serica* Conrad, relatively broader, and less inflated and less prominently sculptured concentrically.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collections.—Maryland Geological Survey, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Monmouth Formation.* Tinton beds, New Jersey. *Ripley Formation. Exogyra costata* zone, ? Owl Creek, Tippah County, Mississippi. *Fox Hills Sandstone.* Western Interior.

Family DREISSENIIDAE

Genus DREISSENA Van Beneden

[Ann. Sci. Nat., ser. 2, vol. iii, 1835, p. 193, pl. viii]

Type.—*Mytilus polymorphus* Pallas.

Equivalve, inequilateral, slightly gaping as a rule, mytiliform in outline; umbones acute, terminal, bent a little forward; anterior area differentiated by a more or less obtusely angulated keel which runs from the umbones to the anterior ventral margin; external surface smooth or incrementally sculptured; ligament internal or submarginal, lodged in a shallow groove, which extends more than a third of the way down to the base; angle between the umbones bridged by a transverse septum upon which the anterior and pedal adductors are mounted and from which, in the right valve, a small dentiform process sometimes projects; posterior adductor scar moderately large, well down towards the base; pallial line rather obscure, entire.

Dreissena is very like *Mytilus* in general aspect, so much so, indeed, that there is probably a considerable amount of confusion between the two genera in the earlier described species. Many authorities maintain that the genus is not initiated until the Early Tertiary. Henry Woods,[1] however, has reported a species, *Dreissensia lanceolata* (Sowerby) Woods from the Cretaceous of England, and has so adequately figured it that there can be no doubt about the correctness of his determination.

The shell differs most conspicuously from that of *Mytilus* in the development of the septum in the umbonal angle and the more internal ligament. The animal differs from that of *Mytilus* in the closed mantle and the two distinct siphons. All of the recent species are denizens of fresh or brackish water.

Etymology: Named in honor of Dreissens, a Belgian physician.

[1] 1900, Mon. Cret. Lamellibranchia, England, Paleontographical Soc., London, pt. ii, p. 110, pl. xviii, figs. 13-15; pl. xix, figs. 1-11.

DREISSENA TIPPANA Conrad

Plate XXXVII, Figs. 8-11

Dreissena tippana Conrad, 1858, Jour. Acad. Nat. Sci., Phila., vol. iii, p. 328, pl. xxxiv, fig. 14.

Dreissena tippana Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 10.

Description.—"Falcate, with distinct lines of growth; front excavated, the margin acutely angular; the dorsal and posterior margin form a regular curve; base rounded; beaks acute."—Conrad, 1858.

Type Locality.—Owl Creek, Tippah County, Mississippi.

Shell thick, prismatic, strongly falcate in outline, evenly convex. acutely keeled from the umbones to the ventral margin, the carinal angle usually more than 90° and giving to the front view of the double valves a canoe-shaped outline; outline of posterior margin evenly rounded from beaks to base; external surface smooth except for incremental striations and, toward the ventral margin, rather pronounced resting stages; ligament groove rather shallow and elongated, hinge edentulous; umbonal septum narrow but quite high; character of muscle impressions and pallial sinus not preserved; inner margins simple.

In Maryland the species is represented chiefly in the form of casts, most frequently of the double valves, to which portions of the brown, prismatic shell substance still adhere, although at some localities perfect specimens have been collected. The form differs quite widely in relative proportions, but it does not seem wise to regard these mutations as of more than individual import.

Occurrence.—MATAWAN FORMATION. Ulmstead Point, Anne Arundel County. MONMOUTH FORMATION. ? Fredericktown, Cecil County; Brightseat, Brooks estate near Seat Pleasant, 1 mile west of Friendly, Prince George's County.

Collections.—Maryland Geological Survey, U. S. National Museum.

Outside Distribution.—*Ripley Formation. Exogyra costata* zone, Georgia; Eufaula, Alabama; Union and Tippah Counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Chattahoochee River, Alabama.

Order ANOMALODESMACEA
Superfamily ANATINACEA
Family PHOLADOMYIDAE
Genus PHOLADOMYA Sowerby

[Genera Recent and Fossil Shells, 1825, pp. 235, 236, pl. xxxvii]

Type.—Pholadomya candida Sowerby.

"The following generic character being drawn up principally from the recent specimen, several particulars will be mentioned in it which cannot be observed in the fossils; there is not, however, the smallest doubt as to their generic identity. Shell very thin, rather hyaline, transverse, ventricose; inside pearly; posterior side short, sometimes very short, rounded; anterior side more or less elongated, gaping; upper edge also gaping a little; hinge with a small rather elongated, triangular pit, and a marginal lamina in each valve, to the outer part of which is attached the rather short external ligament. Muscular impressions two; these, as well as the muscular impression of the mantle, in which there is a large sinus, are indistinct. This shell is the only instance we have ever seen in which the umbones are so approximated as to be worn *through* by the natural action of the animal in opening and closing its valves."—Sowerby, 1825.

Equivalved or subequivalved, inequilateral, transversely elongated or subtrigonal, gaping posteriorly and sometimes anteriorly as well; umbones inflated, anterior; external sculpture radial, often more or less nodose; ligament short, external, opisthodetic; cardinal margin often reflected to form a false area behind the umbones; hinge edentulous excepting a single subumbonal tubercle and pit in each valve; muscle impressions obscure, two in number; pallial sinus profound.

The genus was initiated early in the lower Lias, and though it culminated later in the Jurassic, the decline was not marked until the close of the Mesozoic. The Tertiary representation, however, was very meager and less than half a dozen species have persisted to the present day. As in so many of the ancient types, the few survivors have retreated to unfavor-

Etymology: A name suggested by "its resemblance to shells of two Linnean genera, the *Pholades* and *Mya*."

able regions where the struggle for existence is less keen and they do not have to compete with more virile groups. The few recent forms, including the generic type, *P. candida* Sowerby, inhabit the ocean depths, some of them below the one thousand fathoms line. A single species has been recorded off the Japan coast, one from off the Africa coast and the rest from the Antillean region.

A. Outline subcylindrical; umbones broad, rounded, not conspicuously high .... *Pholadomya occidentalis*
B. Outline ovate-trigonal; umbones relatively narrow, subangulated, conspicuously high .... *Pholadomya conradi*

PHOLADOMYA OCCIDENTALIS Morton

Plate XXXVII, Figs. 1-3

Pholadomya occidentalis Morton, 1833, Am. Jour. Sci., 1st ser., vol. xxiii, p. 292, pl. viii, fig. 3.
Pholadomya occidentalis Morton, 1834, Syn. Org. Rem. Cret. Group, U. S., p. 68, pl. viii, fig. 3.
Pholadomya occidentalis Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 14 *(ex parte)*.
Pholadomya occidentalis Conrad, 1868, Cook's Geol. of New Jersey, p. 727.
Pholadomya occidentalis Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 175, pl. xxiv, figs. 1-3.
Pholadomya occidentalis Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 13.
Pholadomya occidentalis Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 513, pl. lvi, figs. 1-3. (Synonymy excluded.)

Description.—"Oblong-angular, ventricose near the beaks; with twenty-five to thirty narrow, elevated, subtortuous costæ, having broad, slightly concave intervening spaces. Length 2 inches, breadth 3 inches. An extremely variable species. I possess five specimens (all more or less broken), in all of which there is a difference in the number and relative position of the ribs."—Morton, 1833.

Type Locality.—Chesapeake and Delaware Canal.

"The dimensions of an average-sized specimen are: Length about 70 mm., height 47 mm., thickness 45 mm. Shell subovate or subelliptical in lateral outline, and cordate from in front. Hinge line straight, about two-thirds as long as the shell; anterior margin rounding from the cardinal extremity into the basal margin, or obliquely subtrun-

cate; basal margin gently convex, becoming straighter posteriorly; posterior margin more narrowly rounded than the anterior. Beaks large and broad, situated from one-fifth to one-fourth the length of the shell from the anterior extremity, strongly incurved and nearly in contact, moderately elevated above the hinge line. Valves most prominent at about their mid-height in front of the middle of the shell; from this point the surface curves rather abruptly to the ventral anterior and cardinal margins, and much more gently to the gaping posterior margin; the cardinal margins back of the beaks are slightly inflected to form a rather distinct, concave cardinal area of moderate width on each valve. Surface of each valve marked by twenty-five or thirty more or less irregular and wavy, rounded, radiating costæ of moderate strength, much narrower than the intervening depressions, and closer together in the middle of the shell than at either the anterior or posterior portions; in the middle of the shell every other costa on large individuals has usually been intercalated between two others at some distance below the beak; the shell is also marked by more or less irregular, concentric undulations. This species is one of the most characteristic members of the Merchantville clay marl fauna, where it sometimes occurs in considerable numbers."—Weller, 1907.

The species is not known from Maryland, but it occurs in the form of poorly-preserved casts along the Chesapeake and Delaware Canal in Delaware. It is readily recognizable by the well-rounded gibbous valves and the irregular elevated radial liræ. The more southern and apparently later *P. Conradi* described by Conrad under the name of *P. occidentalis* has been accepted as a synonym by the later workers, although the two shells are obviously distinct. The northern form runs larger than the southern, is much more nearly cylindrical and less trigonal in outline, the umbones are broader, more evenly rounded, set farther back from the anterior extremity and very much less prominent.

Occurrence.—MATAWAN FORMATION. Posts 218 and 105, Briar Point, Post 156, Chesapeake and Delaware Canal, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Magothy Formation.* Cliffwood clay, New Jersey. *Matawan Formation.* Merchantville clay marl, Woodbury clay, New Jersey.

PHOLADOMYA CONRADI n. sp.

Plate XXXVIII, Fig. 1

Pholadomya occidentalis **Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv., p. 276.**

Pholadomya occidentalis **Owen, 1860, 2d Rept. Geol. Recon. Ark., pl. viii, fig. 9.**

Description.—"Subovate, very inequilateral, inflated anteriorly; ribs about twenty-five, irregular, prominent, acute, posteriorly distant, crenulated by rugose concentric striæ, on the umbo tuberculato-crenate; summit very prominent; anterior margin obliquely truncated. Length 3¼ inches, height 2¾ inches."—Conrad, 1860.

Type Locality.—Tippah County, Mississippi.

Shell very thin and nacreous, approximately equivalve, very inequilateral; umbones rather narrow and compressed, obtusely angulated, rising high above the dorsal margin, almost at the anterior extremity; anterior end broadly and very feebly arcuate; posterior end symmetrically produced and strongly arcuate; external surface sculptured with twenty-five or twenty-six sharply elevated radial liræ, beaded in the umbonal region by the intersecting incrementals and minutely undulated by the growth sculpture even to the ventral margin.

Pholadomya conradi n. sp. has been confused with *P. occidentalis* Morton, so characteristic of the New Jersey and Delaware Matawan. The later species (*P. conradi*) runs smaller and is less inflated in general outline, while the very high, rather narrow, subangulated umbones, rising from the extreme anterior end of the shell, lend it an aspect that is very characteristic and quite distinct from the subcylindrical outline of *P. occidentalis* Morton.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collections.—Maryland Geological Survey, U. S. National Museum.

Outside Distribution.—Ripley Formation. Exogyra costata zone, Eufaula, Alabama; Union and Tippah counties, Mississippi. *Extreme top of zone,* Chattahoochee River, Alabama.

Family ANATINIDAE

Genus PERIPLOMYA Conrad

[Am. Jour. Conch., July, 1870, vol. vi, p. 76]

= *Leptomya* Conrad, 1867. Not *Leptomya* A. Adams, 1864.

= *Plicomya* Stoliczka, November, 1870.

Type.—Periploma applicata Conrad.

"Elongated, inequivalve, thin, perlaceous, gaping anteriorly; hinge with a projecting spoon-shaped cartilage process, narrowing gradually towards the inferior end, which is acutely rounded; this process joins an oblique callosity which extends to the cardinal margin; an obsolete rib and fissure run obliquely from the anterior side of the apex. This genus, which is allied to *Anatina,* differs from it in having a tapering cartilage process attached to a rib or support which joins the hinge margin anteriorly; and in having the fissure anterior to the apex, and running obliquely towards the anterior extremity of the ventral margin. This genus is known in this country only by one species, which is found in the Ripley group of the Cretaceous era. Judging from external characters and outline of the shells, I should suppose that d'Orbigny's *Periploma robinaldina, P. necomiensis* and *P. simplex* are species of *Leptimya,* which genus probably became extinct with the Cretaceous fauna. The gape of the anterior is moderate, and valves but slightly reflexed, in which respects it differs essentially from *Anatina.*" [1]—Conrad, 1867.

PERIPLOMYA ELLIPTICA Gabb

Anatina elliptica **Gabb, 1862, Proc. Acad. Nat. Sci., Phila. for 1861, p. 324.**
Anatina elliptica **Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 15.**

Etymology: (?) A name suggested by the resemblance of the form to *Periploma* and *Mya*.

[1] Conrad, 1867, Am. Jour. Conch., vol. iii, p. 15.

Anatina elliptica **Conrad, 1868, Cook's Geol. of New Jersey, p. 727.**
Periplomya elliptica **Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 305.**
Periplomya elliptica **Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 177, pl. xxiii, figs. 14, 15.**
Periplomya elliptica **Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 13.**
Periplomya elliptica **Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 522, pl. lvii, figs. 8-11.**

Description.—" Shell subelliptical, equivalve, nearly equilateral; beak central, pointing posteriorly, very small, umbones small. Cardinal margin slightly convex. Buccal margin broad, nearly straight and sloping inwards towards the basal edge, which is very broadly rounded, being nearly straight just opposite the beaks. Anal extremity hardly more than half as broad as the buccal, and with the hinge line between it and the beaks, regularly concave. There is a broadly rounded ridge extending from the umbones towards the anterior basal margin, gradually becoming obsolete as it approaches the edge. Shell thin, and marked on the surface by small, irregular concentric ridges. Length 0.9 inch (from beaks to basal margin), width 1.3 inch."—Gabb, 1862.

Type Locality.—Mullica Hill, New Jersey.

" Shell small, inequivalve, and very inequilateral, subovate in outline, largest across the anterior side of the beaks, and strongly constricted just behind them, the posterior end being narrowed on the hinge line and excavated at this point. Valves somewhat ventricose, the right one less convex than the left, and very decidedly depressed in the central region and toward the basal line, showing a decided twist or arcuation of the valves as seen in a basal view. Anterior end broadly rounded, and the posterior pointedly rounded. Beaks small, appressed, incurved, and apparently directed backward, as is usual in this group of shells, from the expansion of inflation of the anterior side of the hinge line. Cardinal margin, as seen on the cast, inflected both in front of and behind the beaks, forming an apparent lunule and escutcheon on the cast, probably produced mainly from a thickening of the hinge plate within. Muscular imprints and pallial line and hinge not observed."—Whitfield, 1885.

A single imperfect cast has been referred to this species. It shows, however, the compressed valves, the acute umbones and the constriction behind the umbones which characterize the species.

Occurrence.—MONMOUTH FORMATION. Brooks estate near Seat Pleasant, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences.

Outside Distribution.—*Manasquan Formation.* ? New Jersey.

Superfamily ENSIPHONACEA

Family POROMYACIDAE

Genus LIOPISTHA Meek

[Check List Invt. Foss. N. A., Cret. and Jur., 1864, p. 32]

Type.—*Cardium elegantulum* Roemer.

"Shell equivalve, inequilateral, transversely subovate, being usually narrower, more compressed, and often subrostrate behind, and ventricose in the central and umbonal regions, nearly always extremely thin; extremities rounded in outline, the posterior side usually a little gaping; surface granular, and varying, according to the sections and species, from radiately costate on the flanks and front of the valves, to strongly undulate concentrically, with only a few impressed, radiating lines on the middle, or rarely nearly smooth, concentrically striate, or furrowed, with obsolescent radiating striæ; dorsal margins generally inflected so as to form a sort of false area along its entire length; hinge with two prominent cardinal teeth projecting out at right angles from close up under the hinge line, beneath the beak of the right valve (the posterior tooth being larger and compressed, and the anterior pointed), and one prominent and one rudimentary cardinal tooth under that of the left; lateral teeth, none; ligament external; fulcra short and erect. Pallial line unknown.

"*Liopistha* Meek (typical).—Shell transversely subovate, ornamented, excepting on the posterior dorsal portions of the valves, by regular, simple, well-defined, sometimes subcrenate, radiating costæ."—Meek, 1876.[1]

The genus is restricted in its distribution to the Cretaceous.

A. Secondary radial sculpture not developed .... *Liopistha protexta*
B. Secondary radial sculpture developed .... *Liopistha alternata*

Etymology: λεῖος, smooth; ὄπισθεν, behind.

[1] U. S. Geol. Survey Terr., vol. ix, p. 227.

LIOPISTHA PROTEXTA Conrad

Plate XXXVI, Fig. 15

Cardium protextum Conrad, 1853, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. ii, p. 275, pl. xxiv, fig. 12.

Fragilia protexta Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 275.

Papyridea (Liopistha) protexta Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 12.

Liopistha protexta Conrad, 1868, Cook's Geol. of New Jersey, p. 726.

Liopistha protexta Meek, 1876, Rept. U. S. Geol. Survey, Territories, vol. ix, p. 227; text figs. 20-24.

Liopistha protexta Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 140, pl. xx, figs. 1-3.

Liopistha inflata Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 142, pl. xx, figs. 4, 5.

Liopistha protexta Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 13.

Liopistha protexta Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 526, pl. lviii, figs. 4-6.

Description.—"Suboval or subtriangular, inequilateral, ventricose: ribs about twenty-eight in number, narrow, rounded, obsolete on the posterior submargin; posterior extremity obliquely truncated; beaks prominent; basal margin rounded; umbonal slope undefined; posterior end gaping. (A cast.)"—Conrad, 1853.

Type Locality.—Burlington County, New Jersey.

Shell of moderate size and rather heavy for the genus, gaping posteriorly, transversely ovate-trigonal in outline, evenly inflated, the maximum diameter falling near the medial portion of the shell; umbones evenly rounded, the apices proximate, incurved and feebly opisthogyrate, set a little in front of the median vertical and well up above the dorsal margins; anterior and posterior dorsal slopes very gentle, the posterior a little more produced and not quite so low as the anterior; anterior end well rounded, posterior end obscurely truncate; base line strongly and symmetrically arcuate; external surface sculptured with twenty-six to thirty-five angular radials, approximately uniform in size and spacing over the medial portion of the shell, separated by slightly wider concave interspaces; radials diminishing in prominence anteriorly but persistent almost to the margin, evanescing much more abruptly posteriorly, leav-

ing the posterior sixth of the shell smooth; incremental sculpture overrunning the radials and minutely nodulating them in the umbonal region, imbricating them away from the umbones; characters of interior not known.

Liopistha protexta Conrad is abundant and widespread in the Upper Cretaceous of the East Coast and Gulf. For that reason and because its stratigraphic distribution is apparently restricted it has been used by Stephenson[1] as the guide fossil for the so-called *Liopistha protexta* subzone which he has traced through Georgia, Alabama and Mississippi.

Occurrence.—MONMOUTH FORMATION. Bohemia Mills, Cecil County; Millersville, Anne Arundel County; Brightseat, Brooks estate near Seat Pleasant, railroad cut 1 mile west of Seat Pleasant, 2 miles south of Oxon Hill, Prince George's County, Maryland. RANCOCAS FORMATION. Noxontown Pond, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—Matawan Formation. ? Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, Red Bank sand and Tinton beds, New Jersey. *Peedee Formation.* North and South Carolina. *Ripley Formation. Exogyra costata* zone, Eufaula, Alabama; Chickasaw, Lee, Pontotoc, Union, Tippah and Alcorn counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Chattahoochee River, Alabama. *Selma Formation. Exogyra costata* zone, Wilcox County, Alabama; east-central Mississippi.

LIOPISTHA ALTERNATA Weller

Liopistha alternata Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 527, pl. lviii, figs. 7-9.

Description.—"The dimensions of an average left valve are: Length 22 mm., height 15.5 mm., convexity 7 mm. Shell, exclusive of the projecting beaks, subelliptical in outline. Beaks central, or in some specimens apparently a little back of the center, their apices pointed, elevated

[1] Prof. Paper, U. S. Geol. Survey. No. 81.

above the hinge line, strongly incurved and nearly or quite in contact. Antero-cardinal slope slightly concave or nearly straight; anterior margin rather sharply rounded; basal margin broadly and regularly convex; posterior margin rather sharply rounded above to the posterior extremity of the hinge line; post-cardinal slope more concave than the anterior. Valves ventricose or inflated in the umbonal region, the surface curving abruptly to the cardinal margin, convex to the anterior and ventral margins, more or less compressed to the postero-cardinal extremity; slightly gaping posteriorly. Surface marked with forty or more angular, radiating costæ in adult shells, the alternate ones being conspicuously larger. The smaller costæ are intercalated between the larger ones and do not reach the beak, so that in very young shells the alternation of costæ does not exist; upon the posterior, more or less compressed portion of the valves the costæ are nearly or quite obsolete. Distinct impressions of the external surface of the shells show them to be marked by fine, indistinct lines of growth; they also show each costa, both the larger ones and the smaller ones, to be surmounted by a row of fine tubercles or short spines, whose distance apart is less than the spaces between the costæ; the radiating lines of tubercles are also present upon the posterior non-costate portion of the shell. This species can be easily distinguished from *L. protexta* by the alternating costæ and the more central position of the beaks. These two species have never been observed associated in the same fauna, *L. alternata* being characteristic of the Merchantville, while *L. protexta* is especially characteristic of the Navesink."—Weller, 1907.

The occurrence in Maryland is restricted to a single broken valve, but it is sufficient to show the diagnostic development of a secondary radial lineation.

Occurrence.—MATAWAN FORMATION. Summit Bridge, Chesapeake and Delaware Canal, Delaware.

Collections.—Maryland Geological Survey, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, New Jersey. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Georgia; Perry County, Alabama.

Family CUSPIDARIDAE

Genus CUSPIDARIA Nardo

[Ann. Sci., Lombardo Veneto, vol. x, 1840, p. 49]

Type.—Tellina cuspidata Olivi.

Shell minutely pyriform in outline, feebly inequivalve, strongly inequilateral, the anterior portion of the shell inflated, the posterior abruptly constricted and compressed; squarely truncate, gaping.

"The shells of *Cuspidaria* possess an internal ligament, received in each valve in a more or less differentiated groove or fossette, which may project from the umbonal angle of the hinge margin, or be more or less adherent to the anterior or posterior slope of this angle. They may have one anterior and one posterior cardinal and lateral tooth in valve, any one of which (or all in the genus ? *Myonera*) may be entirely absent. Beside the teeth the hinge is reinforced in many cases by a buttress extending in a direction vertical to the valve from the hidden surface of the hinge margin, posterior to the umbonal angle. This buttress may consist of the vertical plate above mentioned and a thickened rib curving round in front of the posterior muscular scar, and then directed posteriorly, becoming almost immediately obsolete. Or the posterior muscular insertion may be elongate and narrow, and the buttress take the form of a "clavicle" or myophore, elongated, parallel with the posterior hinge margin and separating the two posterior muscular scars. The muscles are not always inserted *upon* the buttress, but may be above and in front of it. Its purpose would seem to be that of strengthening the valve, almost always thin and fragile, against sudden contractions of the muscles, and to support the cardinal border, and especially the strong posterior lateral tooth found in many species. When this tooth is found in a species which has no posterior lateral in the other valve, the valve which has a tooth shows the buttress stronger than the other, indicating its function as a support for the tooth; but when elongated and clavicular there is little difference between the buttresses of opposite valves, indicating that in such cases the function is the strengthening of the valve itself. The presence of the buttress is, in my opinion, important only in a minor degree, except

Etymology: *Cuspis, cuspidis;* a lance, a point.

when it takes the clavicular form, as, in different species of the same group, and even in individuals of the same species, its size and prominence vary very greatly. Adriatic specimens of the typical species, *C. cuspidata*, show a strong buttress; British specimens of the same species often show it faintly or not at all, while otherwise well developed. The names *Naera, Rhinomya, Aulacophora, Spathophora*, and *Trophidophora*, among those which have been applied to members of this group, by Gray, Adams, and Jeffreys, are all preoccupied in zoological nomenclature, some of them several times over.

"The characters of radiating and concentric sculpture in this group have no more than a specific value; there are few species where they are not more or less combined in the external ornamentation. The surface may be polished, smooth, wrinkled, sulcate, or granulous. The anterior muscular scar is double or single, the posterior scar double, in all the specimens I have seen where the scars could be made out."—Dall, 1886.[1]

The genus was initiated in the Mesozoic and persists in the recent seas as one of the characteristic deep water forms. One species, *C. lucifuga* Fischer, has been reported from over 2500 fathoms.

A. Latitude of adult shell not exceeding 8 mm.; anterior portion of shell not evenly inflated, tending to flatten toward the anterior lateral and ventral margins.................................*Cuspidaria ampulla*
B. Latitude of adult shell exceeding 8 mm.; anterior portion of shell evenly inflated, not flattened toward the anterior lateral and ventral margins.......................................*Cuspidaria cucurbita*

CUSPIDARIA AMPULLA n. sp.

Plate XXXVII, Figs. 6, 7

Description.—Shell small, even for the genus, thin, approximately equivalve, strongly inequilateral, highly inflated in the umbonal region and the medial portion of the disk, flattening a little toward the anterior and ventral margins of the shell and abruptly compressed posteriorly; umbones inflated even to their apices, proximate, incurved, feebly opisthogyrate, rising well above the dorsal margin, a little in front of the median horizontal; anterior dorsal margin steeply descending; posterior dorsal

[1] Bull. Mus. Comp. Zool., Harvard Coll., 1886, p. 292.

margin feebly excavated; anterior lateral margin rounding obliquely into the base; posterior very short and squarely truncate; base line smoothly convex in the anterior and medial portion, rapidly ascending and very feebly concave behind the median vertical; external sculpture very feeble, little more, indeed, than irregular incremental striations; character of hinge and interior not known.

Dimensions.—Altitude 4.75 mm., latitude 6.75 mm., diameter, 4 mm.

It is separated from *Cuspidaria cucurbita* n. sp. by its smaller size and less produced and less evenly inflated anterior end. The type is unique.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collection.—Maryland Geological Survey.

CUSPIDARIA CUCURBITA n. sp.

Plate XXXVII, Figs. 4, 5

Description.—Shell of moderate size for the genus, oblique, minutely gourd-shaped; subequivalved, the right valve a little the more inflated; umbones gibbous, incurved, the apices proximate and opisthogyrate, placed a little behind the median horizontal; anterior dorsal margin gently sloping; lateral margin obscurely truncate; posterior portion of shell abruptly contracted and compressed behind the umbones; posterior dorsal margin feebly excavated, the short lateral margin squarely truncate; base line arcuate in the anterior and medial portion, rapidly ascending posteriorly; characters of surface and interior not known.

Dimensions.—Altitude 7 mm., latitude 10.5 mm., maximum diameter of double valves 6 mm.

The cast of the double valves from which the shell is described suggests in its outline a miniature drinking gourd, the evenly inflated anterior and medial portion forming the cup, the abruptly constricted posterior portion the neck. The species is probably a close relative of *Cuspidaria ventricosa* Meek and Hayden, but it is much more oblique than the latter, and differs further in that the base line is not excavated at the rostrum. From *Cuspidaria ampulla* n. sp. it is separated not only by the larger size but

by the more produced and much more evenly inflated anterior portion of the shell.

Occurrence.—MATAWAN FORMATION. Three-quarters of a mile southeast of Ulmstead Point, Anne Arundel County.

Collection.—Maryland Geological Survey.

Order TELEODESMACEA

Superfamily CYPRICARDIACEA

Family PLEURORHORIDAE

Genus VENIELLA Stoliczka

(Mem. Geol. Survey of India, Cret. Fauna S. India, 1871, vol. iii, p. 189)

= *Venilia* Morton 1833, Am. Jour. Sci., 1st ser., vol. xxiii, p. 294. Not *Venilia* Dupouch 1829, a Lepidopteran genus.

Type.—*Venilia conradi* Morton.

" Shell ventricose, inflated, with the beaks outwardly incurved, more or less distant, a long narrow ligamental furrow running from them posteriorly, situated above strong fulcra; hinge with two cardinal and one posterior lateral tooth in each valve; right valve with the supra-posterior cardinal tooth, generally bifid anteriorly with a hook-like downward bent prolongation, infero-anterior cardinal smaller, lamelliform, or more or less tubercular, separated from the other tooth by a more or less horizontally extending flexuous groove into which the infero-anterior cardinal tooth of the left valve fits; the supero-posterior cardinal of this valve is moderately prolonged, single or indistinctly bifid."—Stoliczka, 1871.

The shell is rude and heavy and, as a rule, subtrapezoidal or quadrate in outline with a more or less clearly differentiated lunule and escutcheon and an angulated posterior keel. Irregular concentric sculpture is usually developed, but it is rarely more than a modification of the heavy incrementals. The adductor impressions, particularly the anterior, are distinct or even excavated, as is so frequently the case in the heavy bivalves. The pallial line is entire.

The Cretaceous apparently marks the initiation and the culmination of *Veniella,* although it survived in diminished numbers into the Tertiary.

Etymology: A modification of Morton's pre-occupied *Venilia*, the name of one of the nymphs of Roman mythology.

VENIELLA CONRADI (Morton) Stoliczka

Plate XXXVIII, Figs. 2-7

Venilia conradi Morton, 1833, Am. Jour. Sci., 1st ser., xxiii, p. 294, pl. viii, figs. 1, 2.
Venilia conradi Morton, 1834, Syn. Org. Rem. Cret. Group, U. S., p. 67, pl. viii, figs. 1, 2.
Venilia trigona Gabb, 1862, Proc. Acad. Nat. Sci., Phila., for 1861, p. 324.
Venilia conradi Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 13.
Venilia trigona Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 13.
Venilia conradi Conrad, 1868, Cook's Geol. of New Jersey, p. 727.
Goniosoma inflata Conrad, 1869, Am. Jour. Conch., vol. v, p. 44, pl. i, fig. 10.
Venilia elevata Conrad, 1870, *Ibidem*, vol. vi, p. 74, pl. iii, figs. 7, 7a.
Veniella conradi Stoliczka, 1871, Mem. Geol. Survey of India, Pal., Cret. Fauna Southern India, vol. iii, p. 190.
Veniella conradi Meek, 1876, Rept. U. S. Geol. Survey, Territories, vol. ix, p. 148, text figures 9-11.
Veniella conradi Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 144, pl. xix, figs. 8-10.
Veniella trigona Whitfield, 1885, *Ibidem*, p. 149, pl. xix, figs. 11-14.
Veniella inflata Whitfield, 1885, *Ibidem*, p. 147, pl. xix, figs. 4, 5.
Veniella elevata Whitfield, 1885, *Ibidem*, p. 148, pl. xix, figs. 6, 7.
Veniella conradi Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 13.
Veniella trigona Johnson, 1905, *Ibidem*.
Veniella elevata Johnson, 1905, *Ibidem*.
Veniella inflata Johnson, 1905, *Ibidem*.
Veniella conradi Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 534, pl. lviii, figs. 18, 19.
Veniella trigona Weller, 1907, *Ibidem*, p. 537, pl. lix, figs. 1-3.

Description.—" Trigonal, ventricose, concentrically sulcated; beaks long and incurved; diameter an inch and a half."—Morton, 1833.

Type Locality.—New Jersey.

Shell thick, heavy, prismatic, rudely cordate or trigonal in outline; umbones very prominent, inflated to their very apices, which are turned inward and forward, and placed in the adult forms within the anterior third; posterior carina strongly defined, persisting from the umbones to the posterior ventral margin; lunule very wide, differentiated by a faintly incised line and the evanescence of the heavy concentric sculpture; escutcheon suggested by an obscure keel running from the umbones to the extremity of the dorsal margin at a distance a little more than midway

between the posterior carina and the hinge margin; escutcheon much more sharply defined in the young forms than in the adults; anterior portion of shell smoothly rounded, even nasute in the young; base line approximately horizontal; posterior dorsal and distal margins merging into one another in the adults, the lateral margin squarely truncate in the young; external surface broadly corrugated in the umbonal region, the summits of the obtuse ridges thus formed crowned with sharp laminar plates uniform in thickness throughout their extent, although the altitude attained sometimes approaches a centimeter; laminæ often broken away leaving only a faint scar which is soon eradicated by exposure; the number of processes thus developed rarely exceeding five; ventral portion of adult shell evenly rounded and sculptured only with heavy growth lines and crowded resting stages; ligament external, opisthodetic, seated upon a short but rather stout nymph; hinge plate heavy, two cardinals in the right valve, the anterior trigonal and placed opposite the lateral, the posterior robust, obliquely elongated and compressed, feebly sulcated medially; a stout rounded anterior lateral tubercle developed on the ventral side of the hinge plate near the anterior cardinal; posterior lateral grooved, profound, the inner surfaces finely striated transversely; two cardinals present also in the left valve, both of them posteriorly produced, the anterior stout and feebly sulcated, the posterior laminar and united with the basal margin; anterior lateral sharp, trigonal with a deep pocket behind it for the reception of the corresponding lateral in the right valve; posterior lateral elevated, produced; muscle impressions distinct, the anterior excavated; pallial line entire.

The young of the species are subquadrate in outline and when fully armed present a very different aspect from the cordate adults from which the laminar plates have been broken away and all traces of them obliterated. However, all the changes in outline and sculpture may be observed in a single individual so that there is no doubt of the absolute identity of the *V. conradi* and *V. trigona.*

Even though there were, Morton's well-figured type is a fully adult form with all the characters of the individual described later by Gabb under the name of *V. trigona.*

The species is unusually abundant and well preserved at Brightseat, Prince George's County.

Occurrence.—MAGOTHY FORMATION. ? Good Hope Hill, District of Columbia. MATAWAN FORMATION. Post 157, Chesapeake and Delaware Canal, Delaware; Ulmstead Point, Anne Arundel County, Maryland. MONMOUTH FORMATION. ? Millersville, Anne Arundel County; Bohemia Mills, right bank of Bohemia Creek near Scotchman's Creek, Cecil County; east of mouth of Turner's Creek, Kent County; Brightseat, railroad cut west of Seat Pleasant, Brooks estate near Seat Pleasant, 1 mile west of Friendly, McNeys Corners, Fort Washington, Prince George's County, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, Red Bank sand and Tinton beds, New Jersey. *Black Creek Formation.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Georgia; Prentiss County, Mississippi. *Transition beds, Eutaw to Selma. Exogyra ponderosa* zone, *Mortoniceras* subzone, Dallas County, Alabama. *Ripley Formation. Exogyra ponderosa* zone, Barbour County, Alabama. *Extreme top of zone,* Pataula Creek, Georgia. *Selma Formation. Exogyra ponderosa* zone, Lee County, Mississippi. *Exogyra costata* zone, Wilcox County, Alabama; east-central Mississippi.

Superfamily ASTARTACEA

Family CRASSATELLITIDAE

Genus CRASSATELLINA Meek

[Hayden, 2d Rept. Geol. Survey, Territories, 1871, p. 300]

Type.—*Crassatellina oblonga* Meek.

"Shell transversely trapezoidal, equivalve, inequilateral, with free margins closed and smooth within; hinge with two cardinal teeth, and one elongated anterior and one posterior lateral tooth in each valve;

Etymology: Diminutive of *Crassatella.*

anterior cardinal tooth of the left valve trigonal, and deeply emarginate below; posterior very much compressed, oblique, and somewhat elongated; cardinal teeth of right valve diverging, with a triangular pit between for the reception of the larger triangular tooth of the other valve; anterior one small, oblique, and connected at its upper end with the posterior extremity of the anterior lateral; posterior larger, oblique, longitudinally furrowed,[1] and perhaps emarginated below, while just behind and above it there is a narrow oblique slit, or pit, for the reception of the thin anterior cardinal of the other valve; lateral teeth elongated parallel to the cardinal margins; the anterior one of the right valve, and the posterior of the left, apparently continued so as to connect with the upper ends of the cardinal teeth; ligament external; pallial line simple.

"The typical species of this genus has the general external appearance of a *Crassatella,* from which genus, however, it is clearly removed by its hinge characters, though evidently belonging to the same family. Its muscular impressions are faintly defined, as is also the case with the pallial line, which latter, however, can be followed so far back as to leave little or no doubt that it is really simple. The larger trigonal cardinal tooth of the left valve is probably sometimes so deeply emarginate as to give it an A-shape."—Meek, 1876.[2]

Meek's belief in the identity of the two genera has been sustained by later paleontologists. There is no record of the group from other than Cretaceous strata.

CRASSATELLINA CAROLINENSIS (Conrad) Meek

Etea carolinensis Conrad, 1875, Kerr's Geol. of North Carolina, App., p. 6, pl. i, fig. 14.

Crassatellina carolinensis Meek, 1876, Rept. U. S. Geol. Survey, Territories, vol. ix, pp. 119, 120.

Etea carolinensis Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 14.

Etea carolinensis Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 541, pl. lix, figs. 4-6.

Description.—"Shell suboval, short, equilateral, compressed, with distinct lines of growth; posterior end truncated, nearly direct."—Conrad, 1875.

[1] The furrow of this tooth is too strongly defined in fig. 3*d*, of plate 2.

[2] Rept. U. S. Geol. Survey, Territories, vol. ix, pp. 119, 120.

Type Locality.—Snow Hill, North Carolina.

"The dimensions of a shell of average size, preserving both valves, are: Length 33 mm., height 22.5 mm., thickness 14 mm. Length of the largest individual observed, 14 mm. Shell very oblique and inequilateral, the beaks obtuse, slightly incurved, situated about three-eighths of the entire length of the shell from the anterior extremity. Anterior margin somewhat narrowly rounded and passing into the basal margin; basal margin moderately convex anteriorly, becoming straight or usually slightly concave posteriorly; posterior-basal extremity acutely angular; posterior margin rather short, obliquely truncate; postero-dorsal margin straight, except near the beak where it becomes slightly convex, making an angle of about 136° with the truncate posterior margin. Surface of the shell marked with a sharply angular or subcarinate, usually straight, umbonal ridge passing from the beak to the postero-basal extremity of the shell; postero-dorsal slope concave from the umbonal ridge to the cardinal margin, where the shell is sharply inflected to form a large and nearly flat escutcheon; in front of the umbonal ridge a broad, more or less indefinite depression passes from the beak to the sinuosity in the posterior portion of the ventral margin; in front of the beak the surface is inflected to form a rather large and broad lunule. Entire surface of the shell covered with strong, concentric lines of growth which are more or less irregular in the strength of their development. Hinge of right valve with a large bifid cardinal tooth directed obliquely backwards from beneath the beak, and a much smaller simple one directed forward; between these two teeth is a deep triangular pit, and behind the posterior one is a much narrower pit; two large lateral teeth are present, one in front and one behind the beak, the anterior one is nearer the beak with a broad and deep pit between it and the hinge line, the posterior one is more elongate and slender, and is also separated from the hinge line by a deep pit. The hinge of the left valve has two cardinal teeth, a large bifid one immediately beneath the beak and a thin, very oblique one behind, with a large, oblique, triangular pit between the two; there are two strong lateral teeth, one in front and one behind, the anterior one being nearer the beak and usually stronger but not so much extended longitudinally as the posterior one. Muscular

impressions large and strong, of about equal size; pallial line parallel with the truncated posterior margin for a short distance below the posterior muscular impression, then bending abruptly forward and continuing subparallel with the shell margin."—Weller, 1907.

Crassatellina carolinensis Conrad is represented in Maryland and Delaware by a single imperfect cast. The species is apparently one of the most reliable guide fossils of the *Exogyra ponderosa* zone.

Occurrence.—MATAWAN FORMATION. Post 105, Chesapeake and Delaware Canal, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—Matawan Formation. Marshalltown clay marl, New Jersey. *Black Creek Formation.* North and South Carolina. *Peedee Formation.* North and South Carolina. *Eutaw Formation.* Basal. *Exogyra ponderosa* zone, Russell County, Alabama. (Tombigbee sand member). *Mortoniceras* subzone, Georgia; Russell County, Alabama; Prentiss County, Mississippi. *Ripley Formation. Exogyra ponderosa* zone, Barbour County, Alabama. *Exogyra costata* zone, Union County, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia. *Selma Formation. Exogyra costata* zone, east-central Mississippi.

Genus CRASSATELLITES Krüger

[Arch. Neuest. Entd. Urwelt, vol. ii, 1828, 466]

Type.—Crassatella gibbosula Lamarck.

"Shell solid, inequilateral, slightly inequivalve, usually subtrigonal, the posterior end longer; valves closed, the ligament and resilium adjacent and internal; hinge of three cardinals in the right valve, of which the posterior is more or less effaced by the resilium, and two in the left valve; the anterior edge of the right and the posterior edge of the left hinge margin grooved to receive the edge of the opposite valve, which is bevelled to serve as a lateral lamina; sculpture chiefly concentric and often obsolete except near the umbones."—Dall, 1903.[1]

Etymology: *Crassus*, thick, heavy.

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. vi, pp. 1466, 1467.

The genus originated, apparently, in the Cretaceous, culminated in the Tertiary, and is represented in the Recent faunas by some thirty or forty species confined, for the most part, to the tropical seas. In the East Coast and Gulf Eocene, and in the East Coast Miocene, the genus is one of the most prolific and conspicuous of any of the bivalves.

A. Outline ovate or ovate-trigonal, not conspicuously produced along the posterior keel.
  1. External surface incrementally sculptured but not more or less regularly lineated from umbones to base.
    a. Shell very heavy, especially in the umbonal region; posterior carina usually prominent................*Crassatellites vadosus*
    b. Shell not very heavy and uniform in weight; posterior carina not very prominent...................*Crassatellites subplanus*
  2. External surface more or less regularly lineated from umbones to base..................................*Crassatellites linteus*

B. Outline alate, conspicuously produced along the posterior keel. *Crassatellites pteropsis*

CRASSATELLITES VADOSUS (Morton) Johnson

Plate XXXIX, Figs. 1-4

Crassatella vadosa Morton, 1834, Syn. Org. Rem. Cret. Group, U. S., p. 66, pl. xiii, fig. 12.

Crassatella ripleyana Conrad, 1858, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iii, p. 327, pl. xxxv, fig. 3.

Crassatella vadosa Meek, 1864, Check List Inv. Foss., N. A., Cret. and Jur., p. 11.

Crassatella vadosa Stoliczka, 1871, Mem. Geol. Survey of India, Pal. Indica, Cret. Faunas Southern India, vol. iii, p. 295.

Crassatella vadosa Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 310.

Crassatella vadosa Conrad, 1878, Cook's Geol. of New Jersey, p. 726.

Crassatella vadosa Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 116, pl. xvii, figs. 12-15.

Crassatellites vadosus Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 14.

Crassatellites ripleyana Johnson, 1905, *Ibidem.*

Crassatellites subplanus Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 553 *(ex parte)*, pl. lxi, figs. 1, 2(?).

Description.—" Ovato-triangular, slightly compressed; with about thirty distinct, concentric striæ. Length one inch and a quarter; breadth one inch."—Morton, 1834.

Type Locality.—Prairie Bluff, Alabama.

Shell of medium size, thick, heavy, rudely trigonal in outline; anterior and lateral margins rounded, posterior more or less produced and trun-

cated, ventral margin approximately horizontal; umbones orthogyrate or turned a little forward, proximate, often thickened, flattened upon their summits, placed back from the anterior margin a distance of one-third the total latitude; lunule broadly lenticular, sharply defined, the portion in the left valve a trifle broader and more feebly striated by the incrementals than that of the right; escutcheon more sharply defined, broader and a trifle larger in the right valve than in the left; posterior area outlined by an obtuse ridge passing from the umbones to the posterior ventral margin; external surface sculptured with low, concentric ridges close set but irregular in arrangement, suggesting an exaggerated incremental sculpture; a few pronounced resting stages, usually developed toward the ventral margin; radial sculpture manifested only in the sharp denticulations on the inner margins; hinge plate very heavy, ligament pit a small scoop-shaped affair, extending obliquely backward from directly beneath the tips of the umbones; cardinals two in number in the left valve, three in the right, the anterior cardinal of the right very thin and laminar, and fused at the base with the dorsal margin, the middle cardinal heavy, trigonal, transversely striated; the posterior cardinal laminar largely effaced by the resilium, originating near the base of the anterior cardinal and diverging from it at an angle of approximately 60°, cardinals of the left valve much more nearly equal than those of the right, the posterior rather thin, just under the umbones where it forms the anterior margin of the ligament pit, but expanding rapidly toward its ventral extremity; left cardinals striated on their inner faces, separated by a deep trigonal pit for the reception of the right anterior cardinal; small sulcus near the base of the left posterior cardinal provided for the laminar posterior cardinal of the right valve; no trace of true laterals developed but the posterior dorsal margin of the right valve and the anterior dorsal margin of left valve bevelled to function as laterals and received in grooves in the opposite valves; muscle impressions subequal, placed near the median horizontal, the anterior more deeply excavated than the posterior; anterior pedal scar very distinct, set under the hinge plate a little dorsal to the anterior adductor; pallial line entire; inner margins finely crenulated from the ventral extremity of the lunule to the ventral extremity of the escutcheon.

C. vadosus Morton shows a wide range of variation in age characters. The young are thin, rather compressed and truncated but not produced posteriorly; with increasing age the form becomes apparently more inflated because of the umbonal thickening, and obliquely produced posteriorly. (Plate XXXII, Fig. 3.)

Conrad's *C. ripleyana* is doubtless a synonym, which includes the larger and heavier individuals. The young are quite uniform in outline and sculpture, but after the form has passed the typical *C. vadosus* stage there is a strong tendency for it to become produced posteriorly and to develop a rather heavy carina with the concomitant medial depression stage represented by the *C. ripleyana.* The species differs constantly from *C. subplanus* in the heavier, less compressed and more inequilateral shell, the less prominnent keel and the much heavier and more trigonal hinge plate.

Although the species has not been reported from New Jersey it would be by no means surprising if the numerous casts from the Monmouth, which have been referred to *C. subplanus* Conrad, would find their true affinities with *C. vadosus* Morton, which is by far the most abundant representative of the genus in Maryland and constitutes, indeed, one of the major factors in the Monmouth fauna.

Occurrence.—MONMOUTH FORMATION. ? Millersville, Anne Arundel County. Brightseat, railroad cut west of Seat Pleasant, Brooks estate near Seat Pleasant, Fort Washington, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Monmouth Formation.* Navesink marl, and Tinton beds, New Jersey. *Ripley Formation. Exogyra costata* zone, Union and Tippah counties, Mississippi. *Selma Formation. Exogyra costata* zone, Wilcox County, Alabama; east-central Mississippi.

CRASSATELLITES SUBPLANUS (Conrad) Johnson

Crassatella subplana Conrad, 1853, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. ii, p. 274, pl. xxiv, fig. 9.

Crassatella subplana Meek, 1864, Check. List Inv. Foss., N. A. Cret. and Jur., p. 11.

Crassatella subplana Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 121, pl. xviii, figs. 14-16.
Crassatellites subplanus Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 14.
Crassatellites subplanus Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 553 (*ex parte*, synonymy excluded.)

Description.—" Subtriangular, compressed or plano-convex; anterior margin obtusely rounded; posterior extremity subtruncated; posterior basal margin straight or slightly contracted; disk marked with numerous prominent acute concentric ridges and fine concentric lines."—Conrad, 1853.

Type Locality.—Arneytown, New Jersey.

" The dimensions of a small specimen, a nearly perfect right valve, are: Length 36 mm., height 28 mm., convexity 6 mm. Large individuals grow to a length of 50 mm. or more. Shell broadly subovate in outline, beak obtuse, situated about one-third the length of the shell from the anterior extremity. Antero-cardinal margin straight or slightly concave, sloping downward from the beak; anterior margin rounding into the basal margin, moderately convex throughout to the postero-basal extremity, which is obtusely subangular; posterior margin short, truncated nearly vertically or slightly inclined; postero-cardinal margin gently convex, sloping downward from the beak and meeting the posterior margin in an obtuse angle. Surface of the shell with an obtusely angular umbonal ridge, which passes from the beak to the postero-basal angle in nearly a straight line, the post-cardinal slope slightly concave to the cardinal margin; the post-cardinal margin sharply inflected to form a rather deeply excavated escutcheon; antero-cardinal margin inflected to form a deep but rather ill-defined lunule. Surface of the shell marked by regular, somewhat imbricating, concentric lines of growth, and often by a few broader concentric undulations towards the margin. Hinge of the right valve with a strong cardinal tooth transversely striate on its anterior surface, directly beneath the beak. Behind it is a very large and broad triangular pit, with a much smaller secondary pit just behind the lower end of the tooth; in front of the cardinal tooth is a small triangular pit about equal in size to the secondary pit behind, and in front of this pit a low, obscure, tooth-like ridge extends obliquely forward to the upper margin of the anterior mus-

cular scar. Muscular impressions strong and about equal in size. Inner margin of the free edge of the shell crenate. The above description is based largely upon a very perfect right valve from the Marshalltown clay marl near Swedesboro."—Weller, 1907.

The species has a very meager representation in Maryland, and is, apparently restricted in its distribution to the Matawan. It differs from *C. vadosus* Morton, so prolific in the Monmouth of Maryland and the Gulf, in its more compressed valves, less anterior umbones, and much lighter shell, with the consequently thinner hinge plate and less pronounced posterior keel.

Occurrence.—MATAWAN FORMATION. Ulmstead Point, ? Arnold Point, Anne Arundel County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Marshalltown clay marl, Wenonah sand, New Jersey. *Monmouth Formation.* ? Navesink marl, ? Red Bank sand, ? Tinton beds, New Jersey.

CRASSATELLITES LINTEUS (Conrad) Johnson

Plate XXXIX, Figs. 6, 7

Crassatella lintea Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 279, pl. xlvi, fig. 5.

Crassatella lintea Meek, 1864, Check List Inv. Fossils, North America, Cret. and Jur., p. 11.

Crassatella lintea Conrad, 1868, Cook's Geol. of New Jersey, p. 726.

Crassatellites linteus Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 14.

Crassatellites subplanus Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 553, pl. lxi, figs. 3, 4 (*ex parte*, synonymy and figs. 1, 2 excluded.)

Description.—" Subovate or subtriangular, convex, inequilateral; disk concentrically ridged and finally striated, slightly contracted near the umbonal slope, which is rounded; posterior extremity subtruncated; apex slightly prominent; posterior dorsal line nearly straight, very oblique; margin within finely crenulated; lunule long and lanceolate."—Conrad, 1860.

Type Locality.—Alabama.

Shell rather small for the genus and rather thin, compressed, subovate to ovate-trigonal in outline; umbones rising a little above the dorsal margin, their apices acute and prosogyrate, slightly anterior in position; lunule and escutcheon clearly differentiated but very narrow because of the compression of the valves; anterior end broadly and symmetrically rounded in front of the umbones; posterior dorsal margin gently sloping; lateral margin obscurely and obliquely truncate; base line rounding smoothly into the anterior lateral margin, obtusely angulated at the union with the posterior; posterior keel obscure but persistent from the umbones to the posterior ventral margin, better defined by the change in the direction of the growth lines than by any variation in the plane; external surface sculptured with a very irregular concentric lineation, sharpest and most regular in the umbonal region, and occasional more or less accentuated growth lines and resting stages; ligament external, lodged beneath the umbones, the resilium buttressed ventrally by the posterior cardinal which it has largely effaced; medial right cardinal stout, trigonal, subumbonal, transversely striated laterally; anterior cardinal laminar; hinge dentition in left valve restricted to two subequal cardinals, the posterior a little the larger, both of them striated upon their inner faces; no trace of laterals developed but anterior margin of left valve and posterior margin of right valve bevelled to function as laterals and received in shallow sockets in the corresponding valve; muscle impressions distinct, impressed in the adults, placed high up at the distal extremities of the hinge; pallial line simple, distinct, rather distant from the base line.

C. linteus Conrad has been considered, without justification, as the young of some of the clearly allied and larger forms, such as *C. vadosus* and *C. subplanus*. Aside from the fact that it shows no evidence of immaturity, the shell is thinner and more compressed and much less strongly carinated posteriorly than *C. vadosus* of the same size. The resemblance to *C. subplanus* is more striking, but the concentric sculpture is finer and more sharply impressed in the former, and as a rule, the umbones are set farther forward and are more strongly prosogyrate.

C. linteus has a distribution in Maryland very similar to that of *vadosus*, but is very much less prolific.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly, Fort Washington, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Marshalltown clay marl, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, Red Bank sand, Tinton beds, New Jersey.

CRASSATELLITES PTEROPSIS Conrad

Plate XXXIX, Fig. 5

Crassatella pteropsis Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 279, pl. xlvi, fig. 9.

Crassatella pteropsis Gabb, 1860, *Ibidem*, p. 395, pl. lxviii, fig. 28.

Crasatella pteropsis Meek, 1864, Check List Inv. Fossils N. A., Cret and Jur., p. 11.

Crassatella (Pachythærus) pteropsis Conrad, 1869, Am. Jour. Conch., vol. v, pp. 47, 48.

Crassatella (Pachythærus) pteropsis Conrad, 1872, Proc. Acad. Nat. Sci., Phila., p. 50, pl. i, fig. 1.

Crassatella pteropsis Gabb, 1876, *Ibidem*, p. 310.

Description.—" Aliform, very inequilateral, convex anteriorly, posteriorly contracted; umbonal slope slightly carinated below the umbo; posterior side rostrated; surface with minute concentric, impressed lines, very fine and closely arranged on the umbo and summit; margin within finely crenulated."—Conrad, 1860.

Type Locality.—Owl Creek, Tippah County, Mississippi.

Shell rather thin and compressed, not very large, very inequilateral, posteriorly produced and alate in outline; umbones flattened upon their summits, orthogyrate, proximate, set back from the anterior extremity a distance of approximately one-third the latitude; lunule and escutcheon sharply defined, narrowly lenticular, subequal in size, the portion of the lunule in the right valve and of the escutcheon in the left valve shorter, narrower and more strongly sculptured incrementally than the corre-

sponding portion in the opposite valve; anterior end of the shell broadly rounded; posterior end obliquely produced along an obtuse keel which extends from the umbones to the posterior ventral margin; area in front of the keel broadly and feebly depressed, area behind it obliquely flattened; posterior dorsal margin evenly and steeply sloping to a point opposite the pallial line where it is obtusely truncated; ventral margin gently arcuate anteriorly, slightly constricted in front of the carina; external surface sculptured in the umbonal region with sharp concentric ridges, close set and regularly spaced, merging ventrally into an irregular incremental sculpture; posterior keel smooth excepting for faint incrementals and a few sharp ridges at the very apices of the umbones; radial sculpture absent; hinge rather frail, three cardinals in the right valve, two in the left; a laminar anterior, a moderately robust medial and an exceedingly thin, laminar posterior cardinal in the right valve, subequal and moderately heavy anterior and medial cardinals in the left; inner cardinal faces transversely striated; posterior dorsal margin of right valve and anterior dorsal margin of left valve bevelled to function as laterals, received in the opposite valve by corresponding grooves; anterior and posterior muscle and pedal adductor scars distinct; pallial line entire; inner margins very finely crenate.

The species is conspicuous among all other representatives of the genus in the Upper Cretaceous of Maryland by reason of the alate outline and the sharp concentric sculpture in the umbonal region.

Occurrence.—MATAWAN FORMATION. Ulmstead Point, Anne Arundel County. MONMOUTH FORMATION. Brightseat, railroad cut west of Seat Pleasant, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly, McNeys Corners, Prince George's County.

Collections.—Maryland Geological Survey, U. S. National Museum.

Outside Distribution.—Black Creek Formation. North and South Carolina. *Ripley Formation. Exogyra costata* zone, Eufaula, Alabama; Owl Creek, Tippah County, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Chattahoochee River, Alabama.

Superfamily CARDITACEA

Family CARDITIDAE

Genus VENERICARDIA Lamarck

[Syst. des Anim. sans Vert., 1801, p. 123]

Type.—*Venericardia imbricata* Lamarck.

Shell closed; rounded, trigonal or cordate; umbones anterior, prosogyrate; lunule small but deep; escutcheon narrow and elongate; sculpture dominantly radial; ligament external, opisthodetic, parivincular; hinge dentition in the right valve consisting of three oblique cardinals; in the left valve of two; laterals of both valves absent or very feeble; muscle impressions strongly defined; pallial line entire; inner margins crenate.

The genus was initiated in the Cretaceous; the Recent representatives are, for the most part, inhabitants of cooler waters.

VENERICARDIA ? INTERMEDIA (Whitfield)

Cardita intermedia Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 209, pl. xxviii, figs. 14, 15.

Cardita intermedia Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 565, pl. lxii, figs. 6-8.

Description.—"Form of cast transversely elliptical, or transversely ovate, exclusive of the beaks, largest at the posterior end. Valves very ventricose, with strong projecting beaks, which in this condition are moderately distant. Hinge line arcuate. Anterior end narrowly rounded; posterior end more broadly rounded; basal margin strongly curved. muscular scars on the cast small but distinct; margin of the cast showing indications of ten or twelve rather strong radiating ribs between the muscular scars. This is a very ventricose form, and has had strong, enrolled, subanterior beaks, which have been directed slightly upwards as well as forward."—Whitfield, 1885.

The form referred to this species is an inside cast to which a bit of the shell substance still adheres in the umbonal region. It seems a trifle more

Etymology: So-called because of a supposed combination of the characters of *Venus* and *Cardium*.

sponding portion in the opposite valve; anterior end of the shell broa rounded; posterior end obliquely produced along an obtuse keel wh extends from the umbones to the posterior ventral margin; area in fr of the keel broadly and feebly depressed, area behind it obliquely flatte posterior dorsal margin evenly and steeply sloping to a point opposit pallial line where it is obtusely truncated; ventral margin gently a ate anteriorly, slightly constricted in front of the carina; ext surface sculptured in the umbonal region with sharp concentric r close set and regularly spaced, merging ventrally into an irregular mental sculpture; posterior keel smooth excepting for faint increm and a few sharp ridges at the very apices of the umbones; radial scu absent; hinge rather frail, three cardinals in the right valve, two left; a laminar anterior, a moderately robust medial and an exce thin, laminar posterior cardinal in the right valve, subequal and ately heavy anterior and medial cardinals in the left; inner cardin transversely striated; posterior dorsal margin of right valve and dorsal margin of left valve bevelled to function as laterals, receive opposite valve by corresponding grooves; anterior and posterior m pedal adductor scars distinct; pallial line entire; inner marg finely crenate.

The species is conspicuous among all other representatives of in the Upper Cretaceous of Maryland by reason of the alate or the sharp concentric sculpture in the umbonal region.

Occurrence.—MATAWAN FORMATION. Ulmstead Point, Ann County. MONMOUTH FORMATION. Brightseat, railroad cut w Pleasant, Brooks estate near Seat Pleasant, Friendly, 1 mi Friendly, McNeys Corners, Prince George's County.

Collections.—Maryland Geological Survey, U. S. National

Outside Distribution.—*Black Creek Formation.* North Carolina. *Ripley Formation. Exogyra costata* zone, Eufaul Owl Creek, Tippah County, Mississippi. *Extreme top of* z Creek, Georgia; Chattahoochee River, Alabama.

·l.

· ;

ım.

vey.

near

· tumid;

ıntly con-

compressed than Whitfield's type but this may be due merely to the conditions of preservation.

Occurrence.—RANCOCAS FORMATION. South feeder Noxontown Pond, Delaware.

Collections.—Maryland Geological Survey, Columbia University.

Outside Distribution.—*Rancocas Formation.* ? Vincentown sand, Manasquan marl, New Jersey.

Superfamily LUCINACEA

Family LUCINIDAE

Genus MYRTAEA Turton

[Conchy. Insul. Britt,, 1822, p. 133]

Type.—*Venus spinifera* Montagu.

"Shell elongate-oval or subrectangular, moderately convex or compressed, dorsal areas obsolete, the sculpture of the disk chiefly concentric and lamellar; the sculpture less pronounced in the middle of the disk and frequently exhibiting a serrate appearance when the lamellæ cross the bounding carina of lunule or escutcheon; internally with the left laterals usually obsolete and only one right cardinal tooth; cardinals entire; ligament and resilium deep-set but not internal; anterior adductor scar lucinoid but rather short; inner margins entire.

"This group is paralleled in *Phacoides* by several others which want the anterior right cardinal in the adult, but in *Myrtæa* the single right cardinal seems to be normal, while in the subdivisions of *Phacoides* its absence is due to degeneration during the growth of the individual or to the dynamic results of the inthrusting of the lunule, which occupies the space where the anterior cardinal would otherwise develop."—Dall, 1903.[1]

The genus is reported from strata as old as the Jurassic. There has been a tendency to indiscriminately assign all lucinoids to *Lucina,* and it is probable that the occurrence of *Myrtæa* in the Mesozoic strata has been underestimated.

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. v, p. 1357.

MYRTÆA STEPHENSONI n. sp.

Plate XXXIX, Figs. 10, 11

Description.—Shell small, equivalve, inequilateral, valves compressed transversely, oblong to subrectangular in outline; lunule narrow, elongated, distinctly impressed and further differentiated by the absence of surface sculpture; escutcheon not defined; umbones small, broadly but feebly inflated, the apices flattened, acute and prosogyrate, slightly overtopping the dorsal margin a little front of the median horizontal; anterior dorsal margin slightly constricted and feebly excavated in front of the umbones; posterior dorsal margin gently sloping; anterior lateral margin broadly arcuate, the posterior widely truncate; base line feebly convex; external surface sculptured with fine crowded, closely over-lapping concentric lamellæ, attached along their ventral margins, the dorsal margins free and slightly raised near the anterior and posterior extremities of the shell; ligament submarginal, opisthodetic; hinge armature rather feeble, a single triangular cardinal in the right valve; posterior cardinal and anterior and posterior laterals obsolete; left valve armed with two slender, divergent cardinals, the laterals appearing as short, incipient laminar processes near the distal extremities of the hinge plate; muscle scars unequal, the anterior elongated, the posterior smaller and irregular in outline; pallial line simple, distinct.

Dimensions.—Altitude 6.5 mm., latitude 7 mm., semi-diameter 2 mm.

Type Locality.—One mile west of Friendly, Prince George's County.

Named in honor of Dr. L. W. Stephenson of the U. S. Geological Survey.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, 1 mile west of Friendly, Prince George's County.

Collection.—Maryland Geological Survey.

Genus PHACOIDES Blainville

[Manual Malacology, vol. 1, 1825, p. 550]

Type.—*Lucina jamaicensis* Lam.

Shell more or less lenticular; compressed, as a rule, or slightly tumid; umbones low, subcentral, erect or prosogyrate; sculpture dominantly con-

Etymology: φακός, lentil: εἶδος, like.

centric; anterior and posterior dorsal areas usually differentiated; lunule frequently profound; escutcheon obsolete; ligament external, often deeply sunken; normal dentition of right valve consisting of a simple anterior cardinal, a bifid posterior cardinal and anterior and posterior laterals; normal dentition of left valve consisting of a bifid anterior cardinal, a simple posterior cardinal, and anterior and posterior lateral grooves; laterals and less frequently the cardinals often obsolete; muscle impressions strongly marked, the anterior elongate, the posterior oval; inner margins smooth or crenulated; pallial line entire.

The genus is abundantly represented in the Tertiaries, the Mesozoic, and, if it be made to include the *Prolucina* of Dall, may be traced as far back as the Silurian. The living species number more than one hundred, and though they are most prolific in the tropics, they are present in the temperate seas as well.

PHACOIDES NOXONTOWNENSIS n. sp.

Plate XXXIX, Figs. 8, 9

Description.—Shell of moderate size, compressed, subcircular; umbones nearly central, acute, prosogyrate, not very prominent, dorsal slopes gentle, the anterior a little less so than the posterior; lateral margins broadly rounded; base line strongly and symmetrically arcuate; external surface sculptured with acutely elevated concentric laminæ, regularly spaced, probably about twenty-five in number, and between them very faint secondary striations; ligament external, opisthodetic, lodged in a marginal groove elongated parallel to the dorsal margin; dentition obscure, but two small diverging cardinals are distinctly present in each valve; laterals apparently not developed; character of muscle scars and pallial line not known.

Dimensions.—Altitude 26 mm., latitude 26 ± mm., diameter 3.5 mm.

This species is another of those Rancocas bivalves represented by abundant fragments. The concentric sculpture is so well characterized, however, that even a scrap showing the regularly arranged, acutely elevated laminæ is recognizable. As the species constitutes so important a factor in the Rancocas fauna it does not seem wise to disregard it altogether, even though the material is so ill-preserved.

Occurrence.—RANCOCAS FORMATION. South feeder Noxontown Pond, Delaware.

Collection.—Maryland Geological Survey.

Genus TENEA Conrad

[Am. Jour. Conch., vol. vi, 1870, p. 72]

Type.—*Tenea parilis* Conrad.

" A V-shaped tooth under the apex of the left valve,the anterior lobe of which is continued along the margin anteriorly, forming a long, deep pit above it; one distant very oblique cardinal tooth posterior to the apex. Right valve: Two cardinal teeth united above; anterior one falcate, with a pit on each side; posterior one curved and directed obliquely backward." —Conrad, 1870.

The genus in its known distribution is confined to the Cretaceous.

TENEA PARILIS Conrad

Mysia (Diplodonte) parilis Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 278, pl. xlvi, fig. 16.

Tenea parilis Conrad, 1870, Am. Jour. Conch., vol. vi, p. 73, pl. iii, fig. 12.

Tenea parilis Conrad, 1875, Kerr's Geol. of North Carolina, App., p. 8, pl. ii, fig. 25.

Tenea parilis Tryon, 1884, Syst. and Struct. Conch., vol. iii, p. 216, pl. cxix, fig. 72.

Dosinia gabbi Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 161, pl. xxii, figs. 4, 5.

Tenea pinguis Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 163, pl. xxii, figs. 1, 2 (not *T. pinguis* Conrad).

Tenea parilis Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 15.

Tenea parilis Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 572, pl. lxiii, figs. 1-6.

Description.—" Shell suborbicular, equilateral, ventricose, direct; surface entire; hinge with the anterior cardinal channel very profound."—Conrad, 1860.

Type Locality.—Tippah County, Mississippi.

Shell thin, fragile, ovate in outline, moderately convex, slightly inequilateral, lunule and escutcheon not defined; umbones inflated to their very

Etymology: Corruption of *tenuis*, thin.

apices, proximate, incurved and prosogyrate, placed a little in front of the median vertical; anterior and ventral margins well rounded, merging gradually into one another, the outline of the posterior margin sometimes rounded, sometimes obscurely truncate obliquely; external surface smooth excepting for faint incremental striations which are least feeble near the posterior extremity; ligament opisthodetic, lodged in a submarginal groove extending backward for some distance from the tips of the umbones; hinge plate narrow, very fragile; armature in the right valve consisting of a thin, laminar, hook-shaped cardinal directly beneath the umbones, its posterior arm vertically directed, its anterior arm approximately horizontal; right posterior cardinal slender, laminar, obliquely elongated, parallel to the dorsal margin; anterior lateral developed as a thin plate proximate to and directly facing the anterior portion of the hooked cardinal; hinge of left valve consisting of an anterior Λ-shaped cardinal which fits between the left anterior lateral and the vertical arm of the cardinal hook of the right valve; a very thin, laminar, medial cardinal which is accommodated between the anterior lateral and the horizontal arm of the hook, and a thin, laminar, obliquely elongated, posterior cardinal; muscle scars small, not very distinct, placed high up near the distal extremities of the dorsal margins; pallial sinus narrow, but quite deep, steeply ascending; inner margins simple.

This species occurs very abundantly in the form of casts in the Monmouth of Prince George's County, but the shell is so exceedingly thin and so readily flaked off that it is seldom possible to secure a perfect individual.

Occurrence.—MAGOTHY FORMATION. Good Hope Hill, District of Columbia. MATAWAN FORMATION. Post 105, Chesapeake and Delaware Canal, Delaware; ? Ulmstead Point, Anne Arundel County, Maryland. MONMOUTH FORMATION. Fredericktown, Cecil County; Brightseat, Brooks estate near Seat Pleasant, McNeys Corners, Friendly, 2 miles south of Oxon Hill, ? Fort Washington, Prince George's County, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Magothy Formation.* Cliffwood clay, New Jersey. *Matawan Formation.* Merchantville clay marl, Woodbury clay, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, Red Bank sand, Tinton beds, New Jersey.

Superfamily CARDIACEA

Family CARDIIDAE

Genus CARDIUM Linné

[Systema Naturae, ed. x, 1758, p. 678]

Type.—*Cardium costatum* Linné.

Shell usually subequilateral, closed, or slightly gaping, globose, the united valves subcordate laterally; umbones prominent, almost straight or with a slight anterior twist; true lunule and escutcheon absent; sculpture dominantly radial; ribs often granulose, spinose or imbricated; ornamentation of lateral areas particularly of the posterior, often differing from that of the disk; ligament external, opisthodetic; hinge characterized, with a few exceptions, by two cardinals, of which the ventral is the stronger, and one of two posterior and one of two anterior lateral lamellæ in each valve; cardinals more or less twisted; muscle impressions subequal; pallial line simple or slightly sinuous posteriorly; internal basal margins serrate.

The cardiums form a conspicuous element in the faunas of Cretaceous and Tertiary. They are rather fragile, as a rule, and not well adapted to preservation. The external sculpture is frequently formed from a superficial shelly layer which readily breaks away leaving no scar upon the polished surface beneath. For this reason it is difficult to tell when one is dealing with a perfectly fresh specimen. The recent representatives, the so-called cockles, number about two hundred species and are most abundant in the warmer waters.

A. External sculpture not spinose.

1. Altitude of adult shell not exceeding 40 mm.; posterior area flattened; margins sharply serrate............*Cardium eufalense*

2. Altitude of adult shell exceeding 40 mm.; posterior area not flattened; margins not sharply serrate.........*Cardium spillmani*

Etymology: καρδία, **heart.**

B. External sculpture spinose; margins not serrate.
  1. Altitude and latitude approximately equal; outline subequilateral ....*Cardium dumosum*
  2. Altitude greater than the latitude; outline inequilateral.
    a. Anterior abductor muscle scar inconspicuous or obscure. *Cardium tenuistriatum*
    b. Anterior abductor muscle scar conspicuous....*Cardium kümmeli*

CARDIUM EUFALENSE Conrad

Plate XL, Figs. 1, 2

Cardium eufalense Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 282, pl. xlvi, fig. 13.

Cardium eufalense Meek, 1864, Check List Inv. Fossils, North America, Cret. and Jur., p. 12.

Cardium (Trachycardium) eufalense Conrad, 1868, Cook's Geol. of New Jersey, p. 726.

Cardium (Trachycardium) eufalense Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 310.

Not *Cardium eufalense* Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 132, pl. xx, figs. 17-19.

Cardium eufalense Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 577, pl. lxiii, figs. 17-20.

Description.—" Obliquely ovate, rather thick in substance, profoundly ventricose; ribs about thirty-eight, smooth, prominent, acutely rounded, on the posterior slope angular, compressed or carinated; summit prominent; beaks contiguous."—Conrad, 1860.

Type Locality.—Eufaula, Alabama.

Shell rather small for the genus, obliquely cordate in outline, inflated, the maximum diameter above the median horizontal; umbones tumid, elevated above the dorsal margin, the apices incurved and feebly prosogyrate, subcentral in position; dorsal margins approximately straight, the posterior slightly more pronounced than the anterior; anterior lateral margin obscurely truncate, rounding rather abruptly into the dorsal margin and much more broadly into the ventral; posterior area conspicuously flattened, the lateral margin squarely truncate; base line obliquely arcuate; external surface sculptured with thirty-five to forty vigorous radials, crowded and inclined to be flattened upon their summits in the umbonal region, V-shaped and separated by interspaces of approximately equal width toward the ventral margins; costæ twelve to fourteen in number

upon the posterior slope, narrower and more distinctly spaced than upon the anterior and medial portions; incremental sculpture obscure, excepting for an occasional resting stage near the umbonal margin; ligament external, opisthodetic, mounted on short, thickened nymphs; cardinals two in number in each valve, the anterior very stout and conical, springing from directly beneath the umbones, the posterior mere tubercles at the extremities of the nymphs; short but prominent anterior and posterior laterals developed in the left valve, a double anterior and a single posterior in the right; muscle scars rather indistinct placed high up near the extremities of the dorsal margins, the posterior somewhat elongated; pallial line obscure, ventral and lateral margins sharply serrate.

This species is the most abundant representative of its genus within the area under discussion. It is rather smaller than the co-existing species and is best characterized by the flattening of the posterior portion of the shell and the truncation of the posterior lateral margin. The costals are somewhat tubular in structure so that when the outer layer of the shell surface is removed, as it frequently is by weathering, the intercostal areas appear as flat-topped elevations separated by concave depressions.

Occurrence.—MAGOTHY FORMATION. Good Hope Hill, District of Columbia. MATAWAN FORMATION. ? Post 105, Chesapeake and Delaware Canal, Delaware; three-quarters of a mile southeast of Ulmstead Point, Ulmstead Point, Gibson's Island, north shore Round Bay, Severn River, Anne Arundel County, Maryland. MONMOUTH FORMATION. Bohemia Mills, Fredericktown, Cecil County; Brightseat, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly, McNeys Corners, Prince George's County, Maryland.

Collections.—Maryland Geological Survey, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Wenonah sand, New Jersey. *Black Creek Formation.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Blufftown, Georgia. *Ripley Formation. Exogyra ponderosa* zone, Georgia; Barbour County, Alabama. *Exogyra costata* zone,

Georgia; Eufaula, Alabama; Union and Tippah counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Chattahoochee River, Alabama.

CARDIUM SPILLMANI Conrad

Cardium (Lævicardium) spillmani Conrad, 1858, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iii, p. 326, pl. xxxiv, fig. 3.

Cardium (Liocardium) spillmani Meek, 1864, Check List Inv. Fossils N. A., Cret. and Jur., p. 13.

Cardium (Protocardium) perelongatum Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 136, pl. xx, figs. 20-22; pl. xxi, figs. 4, 5.

Pachycardium burlingtonense Whitfield, 1885, *Ibidem*, p. 138, pl. xxi, figs. 6, 7.

Cardium (Lævicardium) perelongatum Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 15.

Cardium (Lævicardium) burlingtonense Johnson, 1905, *Ibidem*, p. 15.

Cardium (Lævicardium) spillmani Johnson, 1905, *Ibidem*, p. 15.

Cardium spillmani Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 583, pl. lxiv, figs. 9-11.

Description.—" Oblong or profoundly elevated, inequilateral, profoundly ventricose; umbo and summit elevated; beaks nearly contiguous; surface with distant irregular grooves on the anterior side, and three to five radiating slightly impressed furrows on the umbonal slope."—Conrad, 1858.

Type Locality.—Owl Creek, Tippah County, Mississippi.

" The dimensions of a nearly perfect internal cast are: Height 87 mm., width 55 mm., thickness 60 mm. Shell more or less narrowly subovate in lateral view, and cordate in end view. Hinge line rather short, arched, extending further downward in front than behind; anterior margin convex, the curvature becoming greater below; basal margin regularly rounded; posterior margin longer and straighter than the anterior, usually slightly convex, sometimes straight or slightly sinuate in the casts a little above the middle. Beaks situated back of the middle of the hinge line, strongly elevated above it in the casts, pointed, incurved, and distinctly curved forward. Umbones prominent, the most prominent portion of the shell being in an oblique line from the beaks to the postero-basal margin, this umbonal prominence being not at all angular. The posterior slope much more abrupt than the anterior, its surface conspicuously

impressed above the middle of the shell about half-way between the top of the umbonal prominence and the posterior cardinal extremity. Muscular impressions large, the anterior ones deeply impressed, the posterior ones scarcely or not at all differentiated from the surface of the casts. The left valve with two strong cardinal teeth beneath the beak with a pit between, right valve with a single cardinal tooth; anterior lateral teeth more remote from the cardinal teeth than the posterior ones, and also apparently much stronger. Inner free margin of the valves crenate along the posterior margin, smooth along the basal and anterior margins. Surface of the shell marked by radiating ribs upon the posterior slope, which in the internal casts at least, continue only from the margin up to the umbonal prominence; central and anterior portions of the shell marked by concentric lines of growth only. Both of the species described by Whitfield from New Jersey as *Cardium perelongatum* and *Pachycardium burlingtonense,* are certainly internal casts of the shell described by Conrad from Mississippi as *Cardium spillmani,* the example to which the last two names was applied being an exceptionally broad specimen. The species is for the most part restricted to the Navesink marl, where it attains its maximum size. The specimens which have been rarely noticed in the Merchantville clay are usually small, although Whitfield's *P. burlingtonense* is a very large example."—Weller, 1907.

The species is represented in Maryland merely by imperfect casts, one of which must have been, when perfect, fully 115 mm. in altitude.

Occurrence.—MATAWAN FORMATION. Post 105, Chesapeake and Delaware Canal, Delaware. MONMOUTH FORMATION. Bohemia Mills, Great Bohemia Creek, 1 mile southeast of Bohemia Mills, right bank of Bohemia Creek between Scotchman's Creek and Bohemia Ferry Bridge, Cecil County, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—Matawan Formation. Merchantville clay marl, New Jersey. *Monmouth Formation.* Navesink marl, New Jersey. *Black Creek Formation.* North and South Carolina. *Peedee Formation.* North and South Carolina. *Eutaw Formation* (Tombigbee sand mem-

ber). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Blufftown, Georgia; Prentiss County, Mississippi. *Ripley Formation. Exogyra costata* zone, Georgia; Eufaula, Alabama; Lee, Union and Tippah counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia. *Selma Formation. Exogyra costata* zone, Wilcox County, Alabama; east-central Mississippi.

CARDIUM DUMOSUM Conrad

Cardium (Criocardium) dumosum Conrad, 1870, Am. Jour. Conch., vol. vi, p. 75.

Cardium (Criocardium) dumosum Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 133, pl. xx, figs. 9 and ? 13 (not figs. 10-12).

Cardium dumosum Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 15.

Cardium dumosum Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 590, pl. lxv, figs. 7-10.

Description.—" Cordate equilateral, ventricose; umbo broad; summit very prominent; ribs very numerous, small, closely arranged, convex; interstices furnished with numerous long slender spines; posterior margin subtruncated or slightly convex; height 1⅛ inch; length the same."—Conrad, 1870.

Type Locality.—Haddonfield, New Jersey.

The spinose cardiums, *C. kümmeli* Weller, *C. dumosum* Conrad and *C. tenuistriatum* Whitfield, are represented in Maryland merely by casts of the interior or fragments of casts of the exterior. Weller has admirably differentiated the three species from material in a better state of preservation than any available from Maryland, and his diagnoses have been quoted at considerable length.

" The dimensions of a large individual are: Height 18 mm., width 18 mm., convexity of one valve 6 mm. Shell subcircular in outline, but slightly inequilateral, moderately convex. Beaks situated at about the middle of the hinge line, rather small and incurved; umbones prominent, the anterior and posterior cardinal slopes about equally steep; shell slightly compressed at both cardinal extremities. Surface of the shell marked with about fifty-four rounded radiating costæ, with interspaces of about equal width; from the bottom of every third interspace on the central portion of the shell there arises a row of laterally flattened spines 1 to

2 mm. in length, their distance apart being about equal to the space occupied by two costæ; the two intervening interspaces are occupied by rows of much smaller tubercles a little compressed laterally, situated at intervals about one-third the distance between the spines in each row. On the anterior and posterior slopes of the shell several rows of spines alternate with single rows of tubercles. The longest spines occur upon the posterior cardinal slope."—Weller, 1907.

The species is represented in Maryland chiefly by casts of the interior, although a few fragments of the exterior surface have been preserved both in the form of casts and of the original shell. The casts are isloated from those of *C. kümmeli* and *C. tenuistriatum* Whitfield by their relatively broader, more globose and much more nearly equilateral outline. It is by far the most abundant of the three species within the area under discussion.

Occurrence.—MATAWAN FORMATION. ? Post 105, Chesapeake and Delaware Canal, Delaware. MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, 2 miles southwest of Oxon Hill, Prince George's County, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Woodbury clay, Wenonah sand, New Jersey. *Monmouth Formation.* Red Bank sand, New Jersey. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, Prentiss County, Mississippi. *Ripley Formation. Exogyra costata* zone, Union and Tippah counties, Mississippi.

CARDIUM TENUISTRIATUM (Whitfield) Weller

Cardium eufalensis Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 132, pl. xx, figs. 18, 19 (not fig. 17). (Not *C. eufalense Conrad*, 1860.)

Cardium (Criocardium) dumosum Whitfield, 1885, *Ibidem*, p. 133, pl. xx, figs. 10-12 (not figs. 9 and ? 13). (Not *C. dumosum* Conrad, 1870.)

Cardium (Criocardium) multiradiatum Whitfield, 1885, *Ibidem*, p. 135, pl. xxi, figs. 1-3. (Not *C. multiradiatum* Gabb, 1860.)

Fragum tenuistriatum Whitfield, 1885, *Ibidem*, p. 139, pl. xx, figs. 15, 16.

Cardium tenuistriatum Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 591, pl. lxv, figs. 13-19.

Description.—" Shell below a medium size, irregularly trapezoidal or subtriangular in outline, highly ventricose and sharply angular along the posterior umbonal ridge, with a nearly vertical postero-cardinal slope. Beaks large, prominent and attenuated, projecting considerably above the hinge line. Anterior side of the shell short and regularly rounded; posterior vertically truncate and the basal line oblique, being prolonged below toward the posterior umbonal angle. Surface marked, on the body of the shell at least, by very fine, semi-obsolete, radiating striæ, the posterior cardinal slope not showing evidences of striations on the cast, the only condition under which it has been observed. Hinge features unknown.

" The shell has all the generic features of the genus *Fragum,* as far as can be determined from the external form, while the striations of the surface are much finer than is usually the case; but no ornamentation can be detected on the striations, and the features of the hinge are not visible. It is the only form of similar character yet known to me in the formations of the state."—Whitfield, 1885.

Type Locality.—Marlborough, New Jersey.

"The dimensions of an internal cast are: Height 44 mm., width 37 mm., thickness 35 mm. Large examples sometimes attain a height of over 60 mm. Shell irregularly subovate in lateral view and cordate in end view. Hinge line arcuate; anterior and basal margins, from the extremity of the hinge line to the middle of the basal margin, describing a nearly regular, arcuate curve; postero-basal margin curving more sharply around the postero-basal extremity of the shell into the posterior margin; posterior margin much straighter than the anterior, usually gently convex but sometimes nearly or quite straight. Beaks situated at about the middle of the hinge line, rather prominent, elevated, pointed and incurved, considerably more prominent in the casts than in the specimens with the shell preserved. Valves gibbous, most prominent, but not angular, along a line from the beaks to the postero-basal extremity, the posterior slope more abrupt than the anterior. Muscular impressions rather large, the posterior one scarcely impressed and often scarcely dis-

tinguishable upon the casts; the anterior ones more strongly impressed. Each valve with a strong, somewhat curved cardinal tooth beneath the beak, with a pit for the reception of the tooth of the opposite valve; in each valve is a single anterior and posterior, rather strong, lateral tooth, somewhat remote but nearly equidistant from the cardinal tooth. The inner free margin of the valves is crenate. Externally the shell is marked by flat, radiating costæ wider than the interspaces; from the interspaces rise rows of laterally compressed spinules or tubercles which are longer and stronger upon the anterior and posterior slopes towards the hinge extremities; on the central portion of the shell each third row of processes is more conspicuous than the two intervening rows, the spines being longer and larger, one of them occupying the space of two or three of the smaller ones of the intervening rows, the smaller ones sometimes being scarcely more than tubercles but little elevated above the surface of the ribs of the shell; upon the anterior and posterior slopes of the shell the rows of larger and smaller spines alternate, there being but a single row of smaller spines between the larger ones.

"This species is by far the commonest and most widely distributed *Cardium* in the Cretaceous faunas of New Jersey. It exhibits considerable variation, especially in the straightness of the posterior margin of the shell and in the prominence of the postero-basal extremity, but the casts can almost always be easily recognized by the strong convexity or gibbosity of the valves, and the abrupt posterior slope as compared with the anterior. The surface markings of the shell most closely resemble those of *C. dumosum,* but the radiating costæ are comparatively broader and flatter with narrower interspaces, and consequently the spines upon the surface are more compressed laterally. *C. dumosum* is also more nearly equilateral, with less convex valves than this species, and does not attain so large a size.

"It has been a matter of much difficulty to determine to what species this common shell should be referred. Previous to the publication of Whitfield's monograph it seems usually to have been referred to *C. multiradiatum,* or to *C. eufalense.* Whitfield has apparently illustrated dif-

ferent individual internal casts of the species under four different specific heads. His figures 18 and 19 of *C. eufalense* represent a more than usually gibbous cast of this species, the true *C. eufalense* being a fundamentally different shell without the spines rising from the interspaces between the ribs, and consequently not even a member of the subgenus *Criocardium*. Whitfield's figures 10 and 11 of *C. dumosum* represent a more than usually rounded form of the species under discussion, the specimen is larger, more convex and has a steeper posterior slope than the true *C. dumosum*. Figure 12 of the same author, an enlargement to illustrate the surface characters of *C. dumosum*, also proves, upon examination of the specimen, to be taken from a member of the species under consideration; the illustration is not an accurate representation of the characters of the specimen, the costæ being too narrow, the interspaces too wide, and the spines not enough compressed laterally. The internal cast used by Whitfield as the original for his figures 1 and 2 of *C. multiradiatum* seems to be a member of this species also; a specimen in the recent collections of the Survey from the Navesink marl near Crawfords Corner agrees almost exactly with this illustration, and it is undoubtedly a member of the species under discussion. The enlarged illustration, figure 3, given to represent the surface characters of this same species, is much overdrawn, the original mould from which the gutta-percha impression was taken being altogether too imperfect to show to what species it belongs."—Weller, 1907.

The casts of *C. tenuistriatum* Whitfield are readily separable from those of *C. dumosum* Conrad by the much higher relative altitude and the truncated posterior margin. The resemblance to the casts of *C. kümmeli* Weller is much closer, but the umbones are somewhat less elevated and less acute and the anterior adductor muscle scar much less prominent.

Occurrence.—MATAWAN FORMATION. Park Point, and ? Ulmstead Point, Anne Arundel County. MONMOUTH FORMATION. ? Jones farm, Burklow's Creek, Cecil County.

Collections.—Maryland Geological Survey, Columbia Univerisity, New Jersey Geological Survey.

Outside Distribution.—Matawan Formation.. Merchantville clay marl, Marshalltown clay marl, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, New Jersey.

CARDIUM KÜMMELI Weller

Cardium kümmeli Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 585, pl. lxvi, figs. 1-3.

Description.—"The dimensions of a rather small internal cast of a right valve are: Height 45 mm., width 34 mm., convexity 17.5 mm. Large individuals sometimes attain a height of 70 mm. or more. Shell subovate in lateral view, cordate in end view. Beaks of the internal casts greatly elevated above the hinge line, pointed and incurved. Hinge line arcuate; anterior margin regularly rounded from the extremity of the hinge line to the middle of the basal margin; postero-basal margin a little more sharply rounded; posterior margin convex, a little straighter than the anterior. Valves strongly convex or gibbous, most prominent, but not at all angular, along an oblique line from the beaks to the postero-basal extremity, the posterior slope more abrupt than the anterior. Muscular impressions large, the anterior ones deeply impressed above, the posterior one scarcely differentiated from the general surface of the casts. Hinge characters not seen. Inner free margins of the valves apparently not crenate. Shell substance thick, rugose externally. The surface markings consist of strongly elevated, rounded, radiating costæ, narrower than the interspaces; on a specimen about 55 mm. in length the distance between these ribs from center to center at the middle portion of the shell margin is about 2 mm. or a little less. Each third interspace is occupied by a row of strong and thick spines rising 1 or 2 mm. above the tops of the costæ when complete, subcircular in cross-section, their bases occupying the entire width of the furrow, the space between successive spines being about equal to the thickness of the spines themselves; in some cases the bases of the spines are thickened longitudinally so that they occupy essentially the entire furrow, in which case the two bounding costæ with the row of spines rising from the intervening furrow appear to form altogether one broad rib supporting a row of strong spines. The two furrows

intervening between the rows of strong spines are each occupied by a row of very much smaller, laterally compressed spines whose bases are more or less connected.

"There is considerable variation shown in the surface markings of different individuals of this species, and the extremes might be taken as the representatives of distinct species or even of distinct subgenera. In its typical form, as seen in the Tinton beds, the species exhibits clearly the characteristics of the subgenus *Criocardium,* the rows of spines rising from the interspaces betwen the radiating costæ of the shell. In some specimens the bases of the larger spines or nodes are confluent and appear to entirely fill the interspace occupied by them, so that the two bounding costæ with the row of spines together seem to constitute a single broad rib crowned with a row of strong nodes. At the same time the rows of secondary nodes are sometimes confluent at their bases and form a continuous secondary rib, perhaps nodose on top, and about equaling in height and size the primary costæ, so that there seem to be three costæ of nearly equal size in the broad interspace between the rows of large nodes and their included bounding costæ. In the extreme development of the rows of secondary nodes their bases are confluent and they increase in size and height so as to occupy the whole of the interspaces, obliterating entirely the primary costæ, so that the surface of the shell is apparently marked by radiating rows of tubercles which apparently do not rise from interspaces between costæ, but directly from the surface, each third row being much larger and stronger than the two intervening ones.

"It is possible that larger collections of more perfectly preserved material than is now available would show that more than one species has been included under this head, but so far as can be determined from present collections, all these forms seem to run together. The typical form of the species, however, is that in which the nodes rise distinctly from the interspaces, showing the characters clearly of the subgenus *Criocardium,* and which has been recognized only in the Tinton beds.

"In its somewhat elongate and slender form, the species in the form of internal casts somewhat resembles the casts of *C. spillmani* and they have sometimes been so identified. It does not grow so large as that

species, however, it lacks the radiating ribs usually impressed upon the posterior slope of *C. perelongatum,* and the anterior muscular scar is not so low in position.

"In the collections of the National Museum at Washington this species is represented by numerous examples from the South, which have usually been referred to *C. dumosum*. These southern specimens are perfectly preserved shells which are smaller than the usual examples from the Tinton beds in New Jersey, but their surface markings are identical with those of the type specimen. The species differs from *C. dumosum* in its more elongate form and in the much coarser surface markings. *C. tippana* is another allied form in which the surface markings are fully as coarse as in *C. kümmeli,* but there is only a single row of smaller tubercles between the larger ones in that species, instead of two as in *C. kümmeli*."—Weller, 1907.

Type Locality.—Beers Hill Cut, New Jersey.

The casts of *C. kümmeli* are characterized by higher, more acute umbones than those of either *C. dumosum* or *C. tenuistriatum*. It is further differentiated from *C. dumosum* by the relatively higher altitude, the less equilateral outline and the more prominent anterior adductor muscle scar.

Occurrence.—MATAWAN FORMATION. Camp Fox, Post 236, Post 218, Camp U & I, Post 196, one-eighth of a mile west of Summit Bridge, Chesapeake and Delaware Canal, Delaware; 1 mile west of Chesterfield, Anne Arundel County, Maryland. MONMOUTH FORMATION. Two miles west of Delaware City, on John Higgins farm, Delaware; Brooks estate near Seat Pleasant, 1 mile west of Friendly, Prince George's County, Maryland.

Collections.—Maryland Geological Survey, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Monmouth Formation.* Navesink marl, Tinton beds, New Jersey. *Ripley Formation. Exogyra costata* zone, Eufaula, Alabama; Quitman, Union and Tippah counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Barbour and Henry counties, Alabama.

Superfamily VENERACEA

Family VENERIDAE

Genus DOSINIA Scopoli

[Introd. ad Hist. Nat. 1777, p. 399]

Type.—Dosinia africana Hanley.

" Animal with a large arcuate foot and closely united siphons. Complete dental formula (the posterior right cardinal, being extremely thin, is often broken off, eroded, or obsolete) $\begin{array}{l} \text{L. } 0101010.010 \\ \text{R. } 1010101.101 \end{array}$. The thick middle cardinals are often bifid or excavated. Valves suborbicular, generally compressed, with a long and strong ligament seated in a groove and enfolding a heavy resilium, lunule small, impressed; escutcheon narrow. nearly linear or absent; hinge plate broad and thick, valve margins smooth; pallial sinus rather long and usually acute, anterior lateral teeth nearly obsolete and usually simple; sculpture usually of elegantly concentric grooves and interspaces, sometimes raised into lamellæ at the borders of the lunule and escutcheon, crossed rarely with weak radial threads; coloration of the recent species rarely disposed in patterns and usually pale, many species being white. The periostracum is usually thin and polished."—Dall, 1903.[1]

The genus was initiated in the Cretaceous but not very well represented. The rather large and rotund shells are, however, very much in evidence in the Tertiary and Recent faunas. The Recent species number about one hundred, and have an almost universal distribution in the temperate and warmer waters.

DOSINIA OBLIQUATA Conrad

Dosinia obliquata **Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 278, pl. xlvi, fig. 2.**

Dosinia obliquata **Meek, 1864, Check List Inv. Fossils N. A., Cret. and Jur., p. 13.**

Description.—" Lentiform, very oblique; beaks almost terminal; minute, concentric, regular, closely arranged, impressed lines on the anterior side."—Conrad, 1860.

Etymology: ***Dosin***, **a Sengalese name used by Adanson as a specific name.**

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. vi, p. 1227.

Type Locality.—Owl Creek, Tippah County, Mississippi.

Conrad's figure somewhat belies his description. The shell is rather small and thin, subcircular and feebly convex; the umbones are rather gibbous for the genus, the apices acute and prosogyrate, rising above the dorsal margin and approximately central, not terminal in position. The area of maximum inflation extends obliquely backward from the umbones to the posterior ventral margin widening toward the base, thus giving to the shell the characteristically oblique aspect which inspired the name. The anterior end is broadly and symmetrically rounded, the posterior obscurely truncated, the base line arcuate. The external surface is sculptured with very fine, overlapping concentric laminæ, most sharp and most regular in th eumbonal region and along the anterior margin. The characters of the interior are not known.

The species is represented in Maryland by a single imperfect valve.

Occurrence.—MONMOUTH FORMATION. Brooks estate near Seat Pleasant, Prince George's County.

Collection.—Maryland Geological Survey.

Outside Distribution.—*Ripley Formation. Exogyra costata* zone, Tippah County, Mississippi.

Genus CYCLINA Deshayes

[Traité Elém., vol. 1, 1849, p. 623]

Type.—*Venus sinensis* Gmelin = *Venus chinensis* Gmelin.

"The dental formula is $\frac{\text{L. } 0101010}{\text{R. } 1010101}$. The fourth, or posterior, right cardinal is nearly obsolete; the one in front of it and the anterior left cardinal are bifid. The shell is suborbicular, nearly equilateral, and plump; the ligament uncovered but deep-set; there is neither a defined lunule nor escutcheon, the sculpture is faint and chiefly concentric, feebly reticulated by radial striæ; the hinge plate is broad, the inner margins of the valves crenulate, the pallial sinus moderate in size, acutely angular in front, and obliquely ascending. There is no trace of lateral teeth; the periostracum is polished and translucent, the coloration tinted, without

Etymology: κύκλος, circle.

a distinct pattern. The typical forms are denizens of China, Japan, and Korea. The two American forms which have been referred to this genus by Deshayes are discussed under the head of *Cyclinella*, and are probably allied to *Mysia*. They differ conchologically by having smooth inner margins to the valves, a defined lunule, no trace of the fourth right cardinal tooth, and purely concentric sculpture."—Dall, 1903.[1]

CYCLINA PARVA n. sp.

Plate XLI, Figs. 5, 6

Description.—Shell porcellanous, rather heavy for its small size, subcircular in outline, moderately inflated, the maximum convexity above the median horizontal; umbones subcentral, rather prominent, with fine prosogyrate apices placed a little in front of the median vertical; lunule and escutcheon not differentiated; dorsal margins obliquely truncate, the anterior shorter and more gently sloping than the posterior; anterior extremity broader and smoothly rounded; posterior extremity obscurely truncate; base line evenly arcuate; external surface smooth, excepting for faint concentric striations and two or three well defined resting stages, the striæ least feeble toward the lateral and ventral margins, but absent altogether in the immediate vicinity of the umbones; ligament external, opisthodetic, mounted on a rather short and slender nymph; cardinals three in number in each valve, radiating fan-like from beneath the umbones, the anterior cardinal in the right valve thin, laminar and somewhat produced, the middle cardinal stouter, widening ventrally, the posterior obliquely produced and asymmetrically bifid; anterior and medial cardinal of the left valve united beneath the umbones, the anterior slender, laminar, elongated, the medial shorter, slightly elongated and stouter, the posterior very slender and not very much produced; adductor scars relatively large, narrow but elongated, placed well up near the extremities of the hinge line; pallial sinus distinct, acutely angulated at about 90°, the breadth and depth approximately equal; pallial line distant; inner ventral margins simple.

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. vi, p. 1234.

Dimensions.—Altitude 3.7 mm., latitude 4 mm., semi-diameter 1.4 mm.

Type Locality.—Brooks estate near Seat Pleasant, Prince George's County.

This small Venerid is quite unique in the molluscan faunas of the East Coast Upper Cretaceous.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Friendly, McNeys Corners, Prince George's County.

Collection.—Maryland Geological Survey.

Genus MERETRIX Lamarck

[Prodrome Nouv. Class. Coq., 1799, p. 85]

Type.—*Venus Meretrix* Linné.

"Shell trigonal, plump, subequilateral, thin, smooth, with a vernicose periostracum and a peculiar olivaceous tone of coloration; lunule and escutcheon not distinctly defined; cardinals three in each valve, with well-marked anterior laterals; the middle left and two anterior right cardinals entire, smooth, the others grooved or bifid; right nymph and posterior left cardinal corrugated; dorsal margins, beyond the hinge plate, grooved to receive the edge of the opposite valve; internal margins smooth, the pallial line with a shallow arcuate flexuosity but no angular sinus."—Dall, 1903.[1]

The genus was initiated in the Cretaceous. The recent species are most abundant in the Pacific.

MERETRIX CRETACEA (Conrad) Weller

Æora cretacea Conrad, 1870, Am. Jour. Conch., vol. vi, p. 72, pl. iii, fig. 8.
Æora cretacea Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 167, pl. xxiii, figs. 16, 17.
Æora cretacea Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 16.
Meretrix cretacea Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 608, pl. lxviii, figs. 4-7.

Etymology: The specific name of the type.
[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. vi, p. 1259.

Description.—" Subtriangular, subequilateral, convex; end margins acutely rounded; umbo slightly prominent; lunule lanceolate, slightly defined by an impressed line; ventral margin rounded."—Conrad, 1870.

Type Locality.—Haddonfield, New Jersey.

" Shell below medium size, the dimensions of an average example are: Height 16.5 mm., approximate length 23 mm., convexity of one valve 5 mm.; somewhat triangularly subelliptical in outline. Valves moderately convex, beaks small, situated anterior to the middle; antero-cardinal margin concave; anterior margin rather sharply rounded above, curving more gently below and passing without interruption into the broadly rounded ventral margin; posterior margin rather short, obscurely subtruncate; post-cardinal margin long, gently convex, meeting the antero-cardinal margin at the beak in an angle of 120°. Postero-cardinal margin somewhat inflected, especially towards the beak; antero-cardinal margin inflected in front of the beak to form a shallow lunule of moderate width. Surface of shell marked by more or less irregular, concentric lines of growth only. Hinge of the left valve with three cardinal teeth diverging from beneath the beak, the two anterior ones of about equal length, extending directly beneath the beak with a triangular pit between them, the posterior one much more oblique and more elongate. In front of the cardinal teeth is a single low lateral beneath the lunule and parallel with the shell margin. In the right valve there are two divergent, bifid cardinal teeth with a pit beneath the lunule for the reception of the anterior lateral tooth of the oposite valve."—Weller, 1907.

The only evidence of the former presence of this species in Maryland and Delaware is a single imperfect cast from the Chesapeake and Delaware Canal.

Occurrence.—MATAWAN FORMATION. Summit Bridge, Chesapeake and Delaware Canal, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Woodbury clay, Marshalltown clay marl, New Jersey.

Genus ANTIGONA Schumacher[1]

[Essai, 1817, pp. 51, 154]

Type.—*Antigona lamellaria* Schumacher.

" Shell smaller and more trigonal, less rotund than *Cytherea* s. s.; the left anterior lateral lamelliform and larger, with a perceptible socket in the right valve; the posterior right cardinal broad and deeply bifid; pallial sinus small, triangular."—Dall, 1903.[2]

Subgenus APHRODINA Conrad

[Am. Jour. Conch., vol. iv, 1869, p. 246]

Type.—*Meretrix tippana* Conrad.

" Shell rounded or suboval, striated or sulcated; hinge in the left valve with three diverging cardinal teeth, the anterior tooth as thick as the middle one or thicker, and a straight, compressed, transversely rugose lateral tooth parallel with the margin of the shell above it; pallial sinus deep, and similar to that in *Caryatis* Roemer."—Conrad, 1868.

" Shell concentrically striated, with a circumscribed lunule, but no defined escutcheon; inner margins smooth; pallial sinus ample, free, ascending, rather rounded in front; hinge with three cardinals in each valve, the right posterior cardinal bifid; an elongate anterior lateral corrugated on both sides and received into a corrugated pit in the right valve; nymphs plain."—Dall, 1903.[3]

ANTIGONA (APHRODINA) TIPPANA Conrad

Plate XL, Figs. 3, 4

Meretrix tippana Conrad, 1858, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iii, p. 326, pl. xxxiv, fig. 18.

Dione tippana Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 13..

Etymology: *Antigone*, daughter to Œdipus.

[1] *Cytherea* Bolten, 1798, (part) Mus. Boltenianum, ed. i, p. 177; 1819, ed. ii, p. 124. *Venus puerpera* Linnæus. Not *Cytherea* Fabricius *(Diptera)*, 1795, Lamarck, 1806, nor H. and A. Adams, 1856.

Callista Fischer, 1887, Man. de Conch., p. 1084. *Venus verrucosa* Linné. Not *Callista* Morch, 1853.

[2] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. vi, p. 1273.

[3] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. vi, p. 1272.

Aphrodina tippana Conrad, 1868, Cook's Geol. of New Jersey, p. 727.
Aphrodina tippana Conrad, 1869, Am. Jour. Conch., vol. iv, p. 246, pl. xviii, fig. 5.
Aphrodina tippana Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 154, pl. xxii, figs. 6, 7.
Aphrodina tippana Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 16.
Meretrix tippana Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 607, pl. lxviii, figs. 1, 2 *(ex parte)*.

Description.—" Subtriangular, obsoletely striated concentrically; anterior sides slightly compressed, with an ascending basal margin, extremity rather acutely rounded, distant from the apex; base a little prominent in the middle, subtruncated on either side; posterior end but slightly more obtuse than the anterior; beaks prominent."—Conrad, 1858.

Type Locality.—Owl Creek, Tippah County, Mississippi.

Shell rather large and heavy, ovate-trigonal in outline, evenly but strongly inflated; lunule narrow, elongated, defined by an impressed line; area behind the umbones somewhat flattened but escutcheon not differentiated; umbones rather prominent by reason of their position at the apex of an angle of a little more than 90°; umbones evenly rounded but not strongly inflated, the apices incurved, prosogyrate, slightly anterior in position; anterior extremity strongly arcuate, even a little nasute in front of the lunule; posterior dorsal margin obliquely arcuate, the lateral margin obscurely truncate; ventral margin convex, more strongly upcurved in front than behind; external surface concentrically striated with a vigorous incremental sculpture which becomes increasingly prominent toward the ventral margin; ligament external, opisthodetic, mounted on rather a slender nymph which extends a little less than half-way down the dorsal margin; cardinals three in number in each valve, the anterior cardinal of the right valve short and slender, the middle cardinal trigonal, the posterior laminar and elongated, anterior cardinal of the left valve trigonal and stouter than that of the right, the middle cardinal rather short and slender, the posterior elongated parallel to the nymph, a single short lateral elongated parallel to the lunular margin in the right valve, received in a double socket in the left; muscle impressions distinct but not conspicuous, the anterior semi-elliptical, the posterior subcircular; pallial line distinct, the

sinus linguiform and obliquely ascending almost but not quite to the median horizontal.

Aphrodina tippana Conrad is one of the most widely distributed and most characteristic species of the *Exogyra costata* zone. Weller has determined some casts from the Matawan of New Jersey by this name, but they seem to show at least a subspecific difference in the shorter, relatively higher outline and the less produced, more broadly rounded posterior end.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Outside Distribution.—Magothy Formation. New Jersey. *Ripley Formation. Exogyra costata* zone, Union, Tippah and Alcorn counties, Mississippi; Georgia; Eufaula, Alabama. *Extreme top of zone,* Chattahoochee River, Georgia.

Genus LEGUMEN Conrad

[Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iii, 1858, p. 325]

Type.—Legumen ellipticus Conrad = *L. planulatum* Conrad.

"Shell equivalve, very inequilateral, flattened; hinge with two very slender teeth in the right valve under the beak, and one posterior, very oblique, prominent, lamelliform tooth."—Conrad, 1858.

Legumen like the associated *Leptosolen* occurs most frequently in the form of casts, but it is readily differentiated from the latter by the relatively greater altitude, the ellipsoidal rather than cylindrical outline, and particularly by the absence of a sulcus across the umbones.

The genus, though quite abundant locally, has a restricted distribution within the Cretaceous.

A. Altitude of shell not more than half the latitude....*Legumen planulatum*
B. Altitude of shell equal to or greater than half the latitude
Legumen carolinense

Etymology: *Legumen*, a bean.

LEGUMEN PLANULATUM Conrad

Plate XL, Figs, 5-7

Solemya planulata Conrad, 1853, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. ii, p. 274, pl. xxiv, fig. 11.
Legumen ellipticus Conrad, 1858, *Ibidem*, vol. iii, p. 325, pl. xxxiv, fig. 19.
Legumen appressus Conrad, 1858, *Ibidem*, p. 325.
Legumen appressa Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 15.
Legumen elliptica Meek, 1864, *Ibidem*.
Legumen planata Meek, 1864, *Ibidem*.
Legumen ellipticus Conrad, 1868, Cook's Geol. of New Jersey, p. 727.
Legumen appressus Conrad, 1868, *Ibidem*.
Legumen planulatus Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 304.
Legumen planulatum Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 184, pl. xxv, figs. 3, 4.
Legumen appressum Whitfield, 1885, *Ibidem*, p. 185, pl. xxv, figs. 6-8.
Legumen ellipticum Whitfield, 1885, *Ibidem*, p. 184, pl. xxv, fig. 5.
Legumen planulatum Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 17.
Legumen appressum Johnson, 1905, *Ibidem*.
Legumen ellipticum Johnson, 1905, *Ibidem*.
Legumen planulatum Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 612, pl. lxix, figs. 3-7.

Description.—" Elliptical, compressed, sides flattened; end margins rounded; hinge and basal margins nearly parallel."—Conrad, 1853.

Type Locality.—Monmouth County, New Jersey.

Shell very thin and porcellanous, much compressed, transversely ellipsoidal in outline, slightly expanding posteriorly; dorsal and ventral margins subparallel; posterior extremity strongly arcuate, anterior end of shell slightly constricted directly in front of the umbones; the lateral margin evenly and strongly convex; lunule and escutcheon not defined; umbones very low and compressed with sharp and prosogyrate apices placed within the anterior third; external surface adorned with a sharp incremental sculpture, almost obsolete in the umbonal region and along the extreme dorsal margin, sharpest and most regular near the anterior ventral margin; radial sculpture not developed; ligament submarginal, seated on a nymph not quite half as long as the posterior dorsal margin; cardinals three in number in each valve; the anterior and middle cardinals of the right valve thin, laminar and rather short, diverging beneath the

umbones at rather a small angle; the posterior cardinal also thin and laminar, finely bifid, much elongated and set close under the nymph to which it is approximately parallel; anterior cardinal of left valve thin and laminar, but quite prominent, fitting between the anterior and middle cardinals of the right valve; the middle and posterior cardinals of the left valve laminar and elongated, the posterior more produced and narrowly sulcate, both of them placed far back under the dorsal margin and diverging from one another and from the ligament nymph at a very small angle in order that they may receive the posterior cardinal of the right valve; muscle impressions small, obscure; pallial line running close to the ventral margin; sinus short, broad, acutely angulated at its anterior extremity.

Occurrence.—MATAWAN FORMATION. Three-quarters of a mile southwest of Ulmstead Point, Anne Arundel County. MONMOUTH FORMATION. Freeman's Creek, Kent County; Brightseat, Brooks estate near Seat Pleasant, Friendly, McNeys Corners, 2 miles south of Oxon Hill, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, Woodbury clay, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, Red Bank sand, New Jersey. *Black Creek Formation.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Georgia. *Ripley Formation. Exogyra ponderosa* zone, Barbour County, Alabama. *Exogyra costata* zone, Schley County, Georgia; Eufaula, Alabama; Union and Tippah counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia. *Selma Formation. Exogyra costata* zone, Wilcox County, Alabama; east-central Mississippi.

LEGUMEN CAROLINENSE (Conrad)

Baroda carolinensis **Conrad, 1875, Kerr's Rept. Geol. Survey, North Carolina, Appendix, pp. 8, 9, pl. ii, fig. 10.**

Description.—" Shell oblong, very inequilateral, convex, with a few slightly impressed concentric furrows; posterior cardinal margin long,

straight, oblique; margins rounded; umbonal slope undefined and regularly convex with post-umbonal slope. This is the first species found in America, and represents an interesting exclusively Cretaceous genus. The hinge fortunately can be obtained in perfection at Snow Hill. The genus is common to the Senonian strata in America, Europe and Southern India."—Conrad, 1875.

Type Locality.—Snow Hill, North Carolina.

Ligament external, opisthodetic, nymphs elongated and produced more than half the length of the dorsal margin; cardinals three in number in right valve, two in left; the anterior and middle cardinals of the right valve rather short, simple and not very heavy, diverging at rather a small angle from beneath the umbones, the posterior cardinal laminar obliquely elongated and placed far back toward the nymph; cardinals of the left valve two in number, the anterior laminar, the posterior shorter but rather stouter, diverging beneath the umbones at an angle of about 25°; space between the anterior cardinal and the dorsal margin wider than that between the posterior cardinal and the nymph; muscle impressions rather large, unequal, the anterior elongated, the posterior subcircular, situated above the median horizontal near the extremities of the hinge plate; pallial sinus broad, moderately deep, horizontally directed, obtuse; inner ventral margins simple.

Occurrence.—MATAWAN FORMATION. Cassidy's Landing, Cecil County.

Collections.—Maryland Geological Survey, U. S. National Museum.

Outside Distribution.—Black Creek Formation. North and South Carolina. *Ripley Formation. Exogyra ponderosa* zone, Barbour County, Alabama.

Genus CYPRIMERIA Conrad.

[Proc. Acad. Nat. Sci., Phila., 1864, p. 212]

Type.—*Cytherea excavata* Morton.

Lentiform; hinge of right valve broad, with a bifid oblique cardinal tooth under the apex, and two oblique acute anterior teeth, with an inter-

Etymology: Κύπρις, Cypris, a surname of Venus and a Lamarckian genus of bivalves.

mediate pit for the reception of the tooth in the opposite valve."—Conrad, 1864.

"This genus is characteristically Cretaceous and has a suborbicular shell feebly concentrically sculptured, rather heavy and moderately convex, without any circumscribed lunule or escutcheon, the ligament external, but set in a depressed area, on each side of which the valves rise to a rounded dorsal limit but without becoming keeled. The internal margins of the valves are smooth. The hinge formula is $\frac{\text{L. } 101010}{\text{R. } 010101}$. The first anterior left cardinal and the anterior two right cardinals are entire, the others grooved or bifid. There is no trace of any lateral tooth. The pallial line is almost simple; a slight flexuosity, as in *Circe,* alone represents the sinus. It is obvious that the animal must have had very short siphons, if any, and cannot have been closely related to *Dosinia,* as supposed by Stoliczka."—Dall, 1903.[1]

A. Adult shell not exceeding 45 mm. in altitude; valves compressed, squarely truncate posteriorly......................*Cyprimeria depressa*
B. Adult shell frequently exceeding 45 mm. in altitude; valves more or less inflated, rounded posteriorly or obliquely truncate. *Cyprimeria major*

CYPRIMERIA DEPRESSA Conrad

Plate XL, Figs. 8-10

Dosinia depressa Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 278, pl. xlvi, fig. 6.

Dosinia depressa Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 13.

Cyprimeria depressa Conrad, 1875, Kerr's Rept. Geol. Survey of North Carolina, Appendix, p. 9.

Cyprimeria depressa Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 308.

Cyprimeria depressa Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 156, pl. xxii, figs. 11, 12. (Synonymy excluded.)

Cyprimeria depressa Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 16.

Description.—"Longitudinally suboval, convex-depressed, inequilateral; dorsal margin somewhat arcuated, subangular at the posterior extremity; umbo flattened; beak not prominent; disk smooth or with a few distant furrows; umbo minutely and elegantly striated concentrically; length considerably more than the height."—Conrad, 1860.

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. vi, p. 1282.

Type Locality.—Eufaula, Alabama.

Shell rather small and thin for the genus, transversely ovate in outline, conspicuously compressed; lunule and escutcheon not differentiated; umbones small, flattened, anterior, the apices acute, prosogyrate and projecting slightly beyond the dorsal margin; umbonal angle not far from 140° ; anterior dorsal slope less gentle, more uniform, and less produced than the posterior, merging gradually into the anterior lateral margin; posterior dorsal margin produced more or less gibbous, very thin and sharp by reason of the bevelling along its inner surface; posterior lateral margin vertically truncate; base line obliquely arcuate, much more strongly so in front than behind; external surface striated with a modified incremental sculpture which is sharp and regular in the immediate vicinity of the umbones, but which becomes less sharp and less regular away from them; resting stages increasingly numerous toward the base line; ligament submarginal, opisthodetic; cardinals three in number in each valve, radiating fan-like from beneath the umbones; anterior cardinal of right valve sharp, elevated, laminar, the middle cardinal broad, low, asymmetrically cuneate, the posterior cardinal even more elevated than the anterior and, like it, thin and laminar, though feebly reinforced upon its anterior surface; anterior cardinal of left valve rather heavy, expanding ventrally, the middle cardinal elevated along its posterior margin, the posterior, thin, sharp, laminar and not very prominent; laterals not developed, though there is a minute and irregular depression a little less than half-way down the posterior dorsal margin of the left valve, which is occupied by a corresponding elevation in the right; muscle scars rather small and obscure, the anterior elongated, the posterior semi-elliptical, placed high up under the extremities of the hinge plate; pallial line simple but truncated posteriorly, far distant from the base line; inner ventral margins simple.

Cyprimeria depresssa Conrad might more properly have been named *compressa,* since the extreme compression of the valve is the most striking diagnostic of the species. It is the smallest member of the genus reported from the area under discussion. The only resemblance sufficiently striking to cause confusion is that with the larger, less compressed *C. cretacea*

Conrad. The latter is, however, less produced posteriorly and its dorsal margin is more gibbous.

Though less conspicuous a factor than *C. major* n. sp., it is almost as abundant in number of individuals in the Monmouth of Prince George's County.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, 1 mile west of Friendly, Fort Washington, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, U. S. National Museum.

Outside Distribution.—Black Creek Formation. North and South Carolina. *Eutaw Formation. Exogyra ponderosa* zone (basal), Russell County, Alabama. (Tombigbee sand member) *Exogyra ponderosa* zone, *Mortoniceras* subzone, Russell County, Alabama. *Ripley Formation. Exogyra ponderosa* zone, Georgia; Russell County, Alabama. *Exogyra costata* zone, Georgia; Eufaula, Alabama; Union and Tippah counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Chattahoochee River, Alabama.

CYPRIMERIA MAJOR n. sp.

Plate XL, Figs. 11, 12; Plate XLI, Figs. 1-4; Plate XLII, Fig. 1; Plate XLIII, Fig. 1

Description.—Shell porcellanous, very heavy and crumbly, and far exceeding all co-existent members of the genus in maximum dimensions; altitude attained fully 95 mm., and latitude 100 mm.; convexity moderately high for the genus, the maximum diameter falling a little above the median horizontal; outline ovate or subtrigonal; umbones evenly but not greatly inflated, the apices rounded, acute, prosogyrate, anterior; lunule not differentiated; escutcheon suggested by the bevelling of the inner surface of the dorsal margin; anterior dorsal slope steeper, more uniform and less produced than the posterior; general direction of the dorsal margins at right angles to one another but swing to a flexure in the posterior slope between one-third and one-fourth of the distance from the umbones to the

lateral margin increasing the angle to 130° or 140°; anterior end of shell broadly and smoothly rounded, posterior obliquely and somewhat obscurely truncate; base line asymmetrically arcuate, more strongly upcurved in front than behind; a narrow posterior area rudely differentiated by the increased prominence of the incremental sculpture, the broad and very shallow depression which is often developed in front of it, and the still more shallow depression along its medial portion; external surface incrementally sculptured, the striations sharp and regular in the immediate vicinity of the umbones, almost obsolete over the medial portion and irregular with occasional resting stages toward the ventral margin, uniformly coarse over the posterior area from the umbones to the base; ligament submarginal, opisthodetic, supported by a robust nymph; hinge plate heavy, hinge armature restricted to three cardinals in each valve, radiating fan-like from beneath the umbones; anterior cardinal of right valve laminar, middle cardinal stout and trigonal, inclined forward, posterior cardinal obliquely elongated, deeply sulcated medially; anterior cardinal in left valve rather stout, expanded ventrally; middle cardinal trigonal, inclined backward; posterior cardinal sharp and laminar, partially fused with the dorsal margin; adductor muscle scars obscure, the anterior elongated, the posterior semi-elliptical, placed high up under the distal extremities of the dorsal margins; pallial line simple but truncated behind, rather distant from the base; inner ventral margins simple.

Dimensions.—Altitude 76.5 mm., latitude 86 mm., semi-diameter 23.5 mm.

Type Locality.—Brightseat, Prince George's County.

This species is much the largest and heaviest member of the genus described from the East Coast or Gulf Cretaceous. *C. alta,* its probable analogue in the Southern Atlantic Cretaceous, is smaller, relatively higher, and more smoothly rounded, especially along the posterior lateral margin.

The variation in outline is rather wide, the young are much more rounded, relatively lower, more evenly inflated and more symmetrical than the adults, while the adults vary quite widely among themselves in relative proportions and in the size of the umbonal angle. The figured specimens are rather extreme but by no means unusual types.

The species is confined to the Monmouth and possibly to the Monmouth of Prince George's County, but within that restricted area it is, with the exception of *Exogyra,* the most conspicuous element in the bivalve faunas.

Occurrence.—MONMOUTH FORMATION. ? Bohemia Mills, Cecil County; Brightseat, Brooks estate near Seat Pleasant, railroad cut west of Seat Pleasant, ? 2 miles southwest of Oxon Hill, Fort Washington, Prince George's County.

Collections.—Maryland Geological Survey, U. S. National Museum.

Superfamily TELLINACEA

Family TELLINIDAE

Genus TELLINA (Linné) Lamarck

[Prodrome, 1799, p. 84]

Type.—*Tellina virgata* Linné.

" The hinge of *Tellina* in the broad sense, when developed to the fullest extent, comprises on each valve an anterior and posterior lateral and two cardinals of which one is grooved or bifid on its distal edge. When the valves are closed the two bifid teeth are central and the simple teeth are respectively anterior and posterior to them. Normally the teeth of the right valve close in advance of the teeth of the left valve, and in the obsolescence of the laterals those of the left valve disappear first. The simple cardinal of the left valve is often very close to and hardly distinguishable from the anterior part of the nymphal callosity, and owing to its fragility is often broken off at the base, leaving hardly a trace, from which circumstances proceed the erroneous diagnoses so common in the literature which ascribe a single left cardinal to sundry species or groups of *Tellina.* No *Tellina* is without two cardinal teeth in each valve, and at least one (anterior) lateral tooth in the right valve, unless it has been deprived of these parts by erosion, fracture, senility, or abnormal growth. . . . .The ligament varies from extremely long and narrow, as in *Phylloda,* to short and high, as in some species of *Angulus.* The nymphs are usually larger and more prominent in thin shells with short ligaments; subcircular species

Etymology: Τελλίνη, a kind of shell-fish.

always have a short ligament. The resilium is usually enclosed in the hemicylindric ligament. In some forms, however, as *Metis* and *Tellidora,* the resilium is much shorter than the ligament and evinces a tendency to become internal as in the *Semelidæ.* The exterior sculpture of the *Tellinas* is emphatically concentric, though fine radial sculpture often exists, it does not, except in the section *Pseudarcopagia,* rival the concentric sculpture in strength. There is no known species with only radial sculpture. Oblique or angular sculpture is rare. The posterior end of the shell is usually flexed to the right and exhibits one or more folds of greater or less prominence. Occasional marked inequality of the valves is observable, and the culmination of the surface ssculpture as it passes over the ridges which radiate from the beaks toward the end of the valves sometimes results in elegant lamelliform prominence."—Dall, 1900.[1]

The genus was initiated in the Jurassic and has been abundantly represented since the late Mesozoic. The recent species are numbered by the hundreds and are particularly characteristic of the tropical and subtropical seas.

A. Altitude of shell approximately one-half the latitude....*Tellina georgiana*
B. Altitude of shell more than one-half the latitude............*Tellina gabbi*

Subgenus ARCOPAGIA Brown
[Ill. Conch. Great Britain, 1827, p. ii, pl. xvi, fig. 8]

" Shell large, solid, rounded, moderately convex, the flexure obsolete; posterior left lateral absent, and the anterior obsolete, other teeth normal; sinus free, ascending obliquely; internal radii thick and strong but ill-defined; sculpture concentric, usually smoothish or not sharply lamellate, sometimes reduced to incremental lines. Warm, temperate, and tropical seas."—Dall, 1900.[2]

TELLINA (ARCOPAGIA) GEORGIANA Gabb

Tellina (Tellinella) georgiana Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 307.
Tellina georgiana Johnson, 1905, *Ibidem*, p. 16.
Tellina georgiana Weller,1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 615, pl. lxx, figs. 1, 2.

---

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. v, pp. 1006-9.
[2] Dall, Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. v, p. 1011.

Description.—"Shell moderately large, elongate; beaks central, elevated, anterior end produced, rounded; base very slightly convex; posterior end subangulated below, arched above; a strong umbonal ridge runs from the beaks to the angle. Surface destroyed on the only specimen I have seen. Length 2.6 in., width 1.25 in. The impression of the hinge is preserved in the matrix, and the shell is so strongly characterized by its form that I have not hesitated to describe it. It is from Pataula Creek, Georgia, in a hard calcareous marl."—Gabb, 1876.

"The dimensions of two specimens are: Length 32 mm. and 46 mm., height 16 mm. and 23 mm. Shell very broadly subtriangular in outline, the beaks nearly central and pointing a little backward, the greatest anterior extension at considerably below the middle. The anterior and posterior cardinal margins meeting at the beak in an angle of about 140° to 150°, curving gently downward in front and behind; anterior margin rather sharply rounded; ventral margin very long and gently convex; postero-basal extremity sharply rounded or subangular; posterior margin nearly vertically subtruncate below, curving forward above and passing into the cardinal margin. Valves depressed convex, with a subangular umbonal ridge extending from the beak to the postero-basal extremity, the surface sloping with a very gentle convex curve to the anterior, posterior and ventral margins; curving much more abruptly to the cardinal margins, but just before reaching the margin the surface is deflected in the casts so as to form a rather narrow flattened area extending from the beak in each direction and gradually dying out before reaching the anterior and posterior extremities of the shell; just beneath the beak this flattened area bears the impressions of the hinge teeth. Surface of the casts smooth, except for a few very faint and indistinct radiating costæ just above the postero-cardinal slope of the valves. Pallial sinus very deep, extending beyond the middle of the shell. Hinge teeth small and weak, situated just beneath the beak, a single one in the left valve with a socket on either side, and two in the right valve with a deep socket between."—Weller, 1907.

The two casts which have been referred to this species are by no means conclusive evidence of its former existence in Maryland.

Occurrence.—MATAWAN FORMATION. Three-quarters of a mile southeast of Ulmstead Point, Anne Arundel County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Wenonah sand, New Jersey. *Ripley Formation. Exogyra costata* zone. *Extreme top of zone,* Pataula Creek, Georgia.

TELLINA (ARCOPAGIA) GABBI n. sp.

Plate XLII, Fig. 2

Peronæoderma georgiana **Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 308.**
Peronæoderma georgiana **Johnson, 1905, *Ibidem*, p. 16.**
Peronæoderma georgiana **Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 617, pl. lxx, figs. 4-6.**

Description.—" Shell small, thin, flattened; elongate, beaks subcentral in one case in the middle, in another a little posterior; cardinal margins sloping about equally towards both ends. Anterior end prominently and narrowly rounded; posterior rounded, subtruncate; base broadly and regularly convex. Surface marked by fine, regular concentric lines. Hinge composed of minute teeth. Length 1.2 in, width 0.8 in."—Gabb, 1876.

Type Locality.—Pataula Creek, Georgia.

Shell rather large for the genus, compressed, ovate, trigonal in outline; umbones flattened, inconspicuous, not over-topping the dorsal margins, slightly posterior; umbonal angle approximately 135°; dorsal margins oblique, the anterior very gentle, the posterior moderately steep; anterior lateral margin broadly and smoothly rounded, the posterior obscurely truncate; base line broadly arcuate; external surface sculptured with very thin, concentric laminæ, their dorsal edges free, but closely appressed; ligament external, opisthodetic, mounted on a nymph almost half the length of the dorsal margin; hinge concentrated, that of the right valve armed with two short, divergent cardinals and an anterior lateral; hinge of left valve and characters of adductor scars and pallial sinus unknown.

Weller suggested that this species might properly be referred to *Tellina,* but he hesitated to do it because Gabb's name was already preoccupied by

another of his species which he had described at the same time from Pataula Creek.

Occurrence.—MONMOUTH FORMATION. ? Mouth of Turner's Creek, Kent County; Brightseat, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly and McNeys Corner, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Woodbury clay, Wenonah sand, New Jersey. *Monmouth Formation.* Red Bank sand, New Jersey. *Ripley Formation. Exogyra costata zone. Extreme top of* zone, Pataula Creek, Georgia.

Genus TELLINIMERA Conrad

[Am. Jour. Conch., vol. vi, 1870, p. 173]

Type.—*Tellinimera eborea* Conrad.

" A more perfect hinge of the left valve of this genus gives the following character: Cardinal teeth two; anterior one V-shaped, nearly direct, or slightly directed anteriorly; the posterior tooth bifid, oblique; posterior lobe thick, and longer than the anterior lobe; cardinal plate comparatively broad laterally, posteriorly channeled; anteriorly with a small pit, apparently for the reception of a lateral tooth."—Conrad, 1870.

Conrad took the unwarranted liberty of changing the name *Tellinimera* to *Tellimera* when he elevated the subgenus to the rank of a genus.

The genus is restricted in its known distribution to the Cretaceous.

TELLINIMERA EBOREA Conrad

Plate XLII, Figs. 5, 6

Tellina (Tellinimera) eborea Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 278, pl. xlviii, fig. 14.

Tellina (Tellinimera) eborea Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 14.

Tellinomera eborea Conrad, 1868, Cook's Geol. of New Jersey, p. 727.

Tellimera eborea Conrad, 1870, Am. Jour. Conch., vol. vi, p. 73.

Tellinimera eborea Tryon, 1884, Struct. and Syst. Conch., vol. iii, p. 169, pl. cxii, fig. 100.

Etymology: Tellina; μέρος, part, share.

Tellimera eborea Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 164, pl. xxiii, figs. 12, 13.

Tellinimera eborea Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 16.

Tellinimera eborea Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 621, pl. lxx, figs. 19(?), 21(?).

Description.—" Equilateral, subtriangular, compressed; reflexed posteriorly, and subangulated; anterior end rounded; disc with concentric, regular, slightly impressed lines; substance very thin; anterior cardinal tooth slightly oblique, the posterior one very oblique."—Conrad, 1860.

Type Locality.—Alabama.

Shell thin, fragile, polished, compressed, inequilateral, transversely trigonal-ovate in outline; umbones flattened, opisthodetic, conspicuous only by reason of their position at the summit of an angle of not far from 100°; posterior area flattened, the keel rather ill-defined, however, and evanescent toward the ventral margin; anterior dorsal slope very gentle, the lateral margin rounding evenly into the horizontal base; posterior dorsal slope very steep, the posterior lateral margin obscurely truncate; external surface sculptured with sharp, concentric striations which are absent in the umbonal region, but grow increasingly deeper toward the ventral margin; ligament external, opisthodetic; hinge with the characters of the genus.

The species superficially resembles *Ænona eufalensis* Conrad but is more compressed, more inequilateral and more strongly striated concentrically.

Occurrence.—MONMOUTH FORMATION. One-half mile east of Millersville, Anne Arundel County; Brightseat, Brooks estate near Seat Pleasant, 1 mile west of Friendly, 2 miles south of Oxon Hill, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, Woodbury clay, Wenonah sand, New Jersey. *Cretaceous.* Alabama.

Genus AENONA Conrad

[Am. Jour. Conch., vol. vi, 1870, p. 74]

Type.—Tellina eufalensis Conrad.

"Equivalved, without fold; hinge character, two compressed very small, widely diverging teeth in the right valve; lunule very narrow, lanceolate, and marked by a deeply impressed line."—Conrad, 1870.

Restricted in its known distribution to the Cretaceous.

ÆNONA EUFALENSIS Conrad

Plate XLII, Figs. 3, 4

Tellina eufalensis Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 277, pl. xlvi, fig. 15.

Tellina eufalensis Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 14.

Ænona eufaulensis Conrad, 1870, Am. Jour. Conch., vol. vi, p. 74.

Ænona eufaulensis Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 168. pl. xxiii, figs. 2, 3. (Hinge incorrectly drawn.)

Ænona eufaulensis Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 16.

Ænona eufaulensis Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 623, pl. lxx, figs. 24, 25. (Hinge incorrectly drawn.)

Description.—"Subtriangular, convex, entire, inequilateral; anterior end subtruncated; hinge margins equally declining; summit not prominent; posterior end acutely rounded; left valve furnished with one bifid and one rudimentary cardinal tooth; lateral distinct."—Conrad, 1860.

Type Locality.—Eufaula, Alabama.

Shell thin, polished, very fragile, rather compressed, transversely elongated, subtrigonal in outline, subequilateral; umbones slightly bulbous at their tips, orthogyrate, placed a little behind the median line; umbonal angle not far from 135°; anterior slope a little more gentle and a little more produced than the posterior; base line evenly and gently arcuate; external surface smooth, excepting for a few incremental striations near the base; bands of concentric color markings frequently retained, the umbones being, as a rule, darker than any other portion of the shell; ligament external, opisthodetic, the nymph short and rather slender; hinge plate narrow; armature of left valve moderately concentrated, consisting of a short laminar cardinal fused anteriorly with the dorsal margin and,

on the other side of the triangular pit, a very short, trigonal cardinal, feebly sulcated longitudinally; anterior and posterior laterals subequal, symmetrically placed with respect to the umbones. double, more elevated medially than toward the extremities; two cardinals developed in the right valve, the anterior short, thin, and laminar, the posterior placed directly beneath the umbones, short but stout and broadly sulcate; dorsal margins bevelled to function as laterals but no true laterals developed; muscle scars rather large but obscure; pallial sinus very broad, reaching approximately to the median vertical not confluent with the pallial line.

The species differs from *Tellinimera eborea* Conrad, which it superficially resembles, in the more nearly equilateral outline due to the relatively shorter and more angular anterior end of the latter. It differs, furthermore, in the absence of the sharp, concentric striations which characterize *T. eborea.*

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly, McNeys Corners, and 2 miles southwest of Oxon Hill, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Woodbury clay, New Jersey. *Ripley Formation. Exogyra costata* zone, Quitman County, Georgia; Eufaula, Alabama; Union and Tippah counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Chattahoochee River, Alabama.

Genus LINEARIA Conrad

[Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, 1860, p. 279]

Type.—*Linearia metastriata* Conrad.

"Oval or oblong; cardinal teeth in the left valve two, the anterior one elongated, very oblique, the other under the apex small and bifid."—Conrad, 1860.

"The hinge shows two small, diverging, nearly equal teeth, directed obliquely forward, the anterior one very oblique; and two rather long

Etymology: ***Linearis,*** **lineated.**

lateral very distinct pits, the posterior one very distant from the apex. The pallial sinus is rounded and extends to a direct line between the apex and ventral margin, according to d'Orbigny's figure 5, and beyond that point in figure 17. The present species approaches figure 5 most nearly in outline, but the radiating lines over the whole disk is a distinguishing character, and the height of the shell is proportionally less."—Conrad, 1870.[1]

The shell is rather small, equivalved and subequilateral, moderately heavy, more or less elongated transversely, with well-rounded lateral margins. The characteristic sculpture is a radial lineation with intersecting concentric striæ. The genus is restricted in its known distribution to the Cretaceous.

LINEARIA METASTRIATA Conrad

Linearia metastriata Conrad, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 279, pl. xlvi, fig. 7.
Linearia metastriata Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 14.
Linearia metastriata Conrad, 1870, Am. Jour. Conch., vol. vi, p. 73, pl. iii, fig. 11.
Linearia metastriata Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 165, pl. xxiii, figs. 6, 7.
Linearia metastriata Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 16.
Linearia metastriata Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 618, pl. lxx, figs. 8, 9.

Description.—" Oblong-oval, convex, subequilateral; posterior end subtruncated; disk with fine concentric lines and distinct radiating lines anteriorly, and larger crenulated radii posteriorly; the rest of the surface with microscopic radiating lines; cardinal tooth under the apex widely bifid; lobes small and slender."—Conrad, 1860.

Type Locality.—Eufaula, Alabama.

Shell transversely oval in outline; anterior end evenly rounded, posterior obscurely truncate; external surface very finely cancellated, concentric sculpture of fifty to sixty acute lirations, which evenly override the radials in the medial portion of the disk but are minutely undulated by

[1] Am. Jour. Conch., vol. vi, 1870, p. 73.

them anteriorly and even more sharply posteriorly; radial sculpture confined to striations on the interspaces between the concentric liræ on the medial portion of the disk, appearing posteriorly as six to nine low, radiating liræ, unequal in size and spacing; radial sculpture on anterior portion of shell much finer and sharper; radials twelve to fifteen in number, approximately uniform in size and spacing, nodulated by the overriding concentric laminæ; ligament external, opisthodetic, mounted on rather a slender nymph which is separated from the rest of the shell by a linear sulcus; hinge of left valve armed with two laminar cardinals, the posterior a little more slender than the anterior, their inner faces flattened and proximate, diverging at a very small angle and subparallel to the dorsal margin; a single moderately robust, posteriorly directed cardinal developed in the right valve with rather a deep pit in front of it and a more shallow one behind it for the reception of the cardinals of the left valve; a feeble elevation on the forward margin of the anterior socket, probably the analogue of the anterior cardinal in the right valve; dorsal margins of right valve bevelled to function as laterals, received in the left by double grooves which are developed at the distal extremities of the hinge plate; characters of muscle scars and pallial sinus obscure.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Friendly, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Magothy Formation.* Cliffwood clay, New Jersey. *Matawan Formation.* Merchantville clay marl, Woodbury clay, Marshalltown clay marl, Wenonah sand, New Jersey. *Monmouth Formation.* Red Bank sand, New Jersey. *Black Creek Formation.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, *Mortoniceras* subzone, Stewart County, Georgia. *Ripley Formation.* *Exogyra costata* zone, Quitman County, Georgia; Eufaula, Alabama; Union, Tippah and Alcorn counties, Mississippi. *Extreme top of zone.* Pataula Creek, Georgia.

Family PSAMMOBIIDAE

Genus SOLYMA Conrad

[Am. Jour. Conch., vol. vi, 1870, p. 75]

Type.—*Solyma lineolatus* Conrad.

"Two direct approximate teeth under the apex of right valve. The anterior tooth thick and rounded anteriorly. This genus is allied to *Leptosolen* Conrad, but wants the internal rib of that genus and differs also in having two teeth in the right valve."—Conrad, 1870.

Shell equivalve, inequilateral, thin, transversely ovate in outline; an obtuse posterior carina more or less obscurely developed; external surface feebly sculptured concentrically; pallial sinus apparently profound.

If Weller was right in his observation on the pallial sinus of the type species the genus would be allied to the *Psammobiidæ* rather than with the *Solenidæ*. Restricted in its known distribution to the Upper Cretaceous.

SOLYMA LINEOLATA Conrad

Plate XXXVI, Figs. 20, 21

Solyma lineolatus Conrad, 1870, Am. Jour. Conch., vol. vi, p. 75, fig. 9.
Solyma lineolatus Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 305.
Solyma lineolatus Tryon, 1884, Struct. and Syst. Conch., vol. iii, p. 134, pl. cv, fig. 89.
Solyma lineolata Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 182, pl. xxv, figs. 11-13.
Solyma lineolata Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 17.
Solyma lineolata Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 629, pl. lxxi, figs. 3-5.

Description.—"Equilateral, ventricose, substance very thin; anteriorly slightly contracted, end margin rounded; posterior margin obtusely rounded; umbonal slope rounded; ventral margin nearly straight in the middle; disk ornamented with minute and very closely arranged lines. Length 1⅛ in., height ¾ in. The figure represents the hinge of the right valve. Left valve unknown."—Conrad, 1870.

Type Locality.—Haddonfield, New Jersey.

"The dimensions of the type specimen are: Length 26 mm., height 15.5 mm. Shell subquadrangular in outline, a little broader behind than

in front; beaks broad, rather strongly elevated above the hinge line, nearly central in position and directed anteriorly. Hinge line nearly straight, the anterior and posterior portions sloping very gently on each side of the beak; antero-cardinal margin concave; anterior margin rounding from the cardinal into the basal margin; basal margin nearly straight or slightly convex in the middle, curving upward a little more abruptly in front than behind; postero-basal extremity rounded; posterior margin nearly vertically truncate; post-cardinal extremity obtusely subangular; post-cardinal margin straight. Valves moderately convex, with an obscure, rounded, umbonal ridge along both the anterior and posterior umbonal slopes; the cardinal margins inflected both in front of and behind the beaks. Surface of both valves in the casts marked by rather fine, more or less irregular, concentric lines of growth.

"This shell, in its general outline, somewhat resembles *Periplomya elliptica,* but with the extremities of the shell reversed, the anterior extremity of that species being the broader and the beak being directed backward. In *Solyma lineolata,* however, the posterior margin is truncate while the anterior margin of *P. elliptica* is rounded, and the anterior extremity is much broader than the posterior extremity of that shell. The two more or less obscure umbonal ridges are also a distinguishing mark of this species, but these ridges have been made too conspicuous in Whitfield's illustration of the species. Upon one of the internal casts of this species which has come under observation, there seems to be an impression of a very deep pallial sinus extending forward to the center of the shell."—Weller, 1907.

Ligament, as implied by Conrad's figure, external, opisthodetic, seated upon a marginal nymph, armature of right valve consisting of two slender laminar teeth, diverging at a small angle from beneath the umbone.

Represented in Maryland by a single imperfect cast.

Occurrence.—MAGOTHY FORMATION. Good Hope Hill, District of Columbia.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—Magothy Formation. Cliffwood clay, New Jersey. *Matawan Formation.* Merchantville clay marl, Woodbury clay, Wenonah sand, New Jersey. *Monmouth Formation.* Red Bank sand, New Jersey.

Superfamily SOLENACEA

Family SOLENIDAE

Genus LEPTOSOLEN Conrad

[Am. Jour. Conch., vol. iii, 1867, p. 15]

Type.—Siliquaria biplicata Conrad.

" Elongated, thin in substance, straight with the dorsal and ventral margins parallel; plicated anteriorly; open at both ends; beaks not nearly terminal; hinge of the right valve with one direct tooth, convex anteriorly, truncated behind; an internal rounded direct rib commences under the cardinal margin, gradually becomes less prominent and disappears towards the ventral margin."—Conrad, 1867.

The ligament is external mounted on elongated nymphs. The pallial sinus is very shallow. Dall[1] considers that the shell characters are intermediate between those of *Solen* and *Siliqua.*

The genus is restricted in its known distribution to the Middle and Upper Cretaceous.

A. Clavicular rib vertical.............................*Leptosolen biplicata*
B. Clavicular rib oblique, directed backward............*Leptosolen elongata*

LEPTOSOLEN BIPLICATA Conrad

Plate XLII, Figs. 7, 8

Siliquaria biplicata Conrad, 1858, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iii, p. 324, pl. xxiv, fig. 17.
Siliquaria biplicata Gabb, 1861, Syn. Moll. Cret. Form., p. 226 (170).
Siliquaria biplicata Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 15.
Leptosolen biplicata Conrad, 1867, Am. Jour. Conch., vol. iii, pp. 15, 138.
Leptosolen biplicatus Conrad, 1868, Cook's Geol. of New Jersey, p. 727.

Etymology: λεπτός, thin; *solen.*
[1] Dall, 1900, Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. v, p. 950.

Leptosolen biplicata Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 304.
Leptosolen biplicata Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 183, pl. xxv, figs. 1, 2.
Leptosolen biplicata Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 17.
Leptosolen biplicata Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 624, pl. lxx, figs. 30, 31.

Description.—" Thin, convex, with two radiating folds or depressions anteriorly; basal line slightly contracted or incurved; anterior side short; extremity truncated; posterior margin obtusely rounded, posterior side concentrically lineated; valves somewhat contracted obliquely from beak to base."—Conrad, 1858.

Type Locality.—Owl Creek, Tippah County, Mississippi.

Shell very thin, porcellanous, compressed, rudely cylindrical in outline; dorsal and ventral margins parallel, the posterior symmetrically arcuate, the anterior rounding, somewhat obliquely, into the base; lunule and escutcheon not defined; umbones very inconspicuous, scarcely rising above the dorsal margin, set back from the anterior extremity a distance of approximately one-fourth the total latitude; posterior area differentiated by the abrupt strengthening of the concentric sculpture along a line extending from the umbones to the posterior extremity of the basal margin, concentric sculpture reduced to faint and rather irregular incremental striations upon the anterior and medial portions of the shell, least feeble medially and appearing upon the posterior area as sharp-edged, regularly overlapping concentric laminæ; radial sculpture not developed; ligament marginal, opisthodetic, seated upon a nymph about one-eighth as long as the posterior dorsal margin; a single very prominent subumbonal cardinal in each valve; shell reinforced within by a rather heavy deposit of calcite along a vertical dropped from the umbones, the ridge thus formed broadest and most elevated dorsally and gradually evanescing toward the base; muscle scars subequal, inconspicuous; pallial sinus profound.

Casts of the interior are remarkable for their cylindrical outline and for the deep sulcus formed by the internal rib, which cuts across the umbone and persists a little more than half-way down to the ventral margin.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, 1 mile west of Friendly, 2 miles southwest of Oxon Hill, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Magothy Formation.* Cliffwood clay, New Jersey. *Matawan Formation.* Merchantville clay marl, Woodbury clay, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, Red Bank sand, New Jersey. *Black Creek Formation.* North and South Carolina. *Eutaw Formation* (basal). *Exogyra ponderosa* zone, Chattahoochee County, Georgia. (Tombigbee sand member.) *Exogyra ponderosa* zone, *Mortoniceras* subzone, Stewart County, Georgia. *Ripley Formation.* *Exogyra ponderosa* zone, Stewart County, Georgia. *Exogyra costata* zone, Eufaula, Alabama; Union, Tippah and Alcorn counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia; Chattahoochee River, Alabama.

LEPTOSOLEN ELONGATA Weller

Leptosolen ? elongata Weller, 1907, Geol. Survey of New Jersey, vol. iv, p. 627, pl. lxx, figs. 27, 28.

Description.—"The dimensions of the type specimen, a cast of the left valve, are: Length 24 mm., height 8 mm., convexity 2.5 mm. Shell elongate, dorsal and ventral margins subparallel; anterior margin rounded, its greatest extension above the mid-height; posterior margin probably rounded or truncate, not completely preserved. Beaks small, terminal, but little elevated above the hinge line. Valves closed in front, apparently gaping behind; the surface regularly convex from the dorsal to the ventral margin, curving a little more abruptly above and inflected to the hinge line in the anterior half of the shell; curving abruptly to the anterior margin in front. In the cast a strong, deep, sharply defined furrow extends downward from the beak towards the ventral margin, and a little obliquely backward, curving a little posteriorly near its lower extremity; another much less conspicuous furrow originates beneath the beak with the first one, and extends backward, parallel with the hinge line,

becoming obsolete near the center of the shell. Surface of the cast apparently smooth."—Weller, 1907.

Type Locality.—Middletown, New Jersey.

Leptosolen elongata is much smaller than *Leptosolen biplicata* Conrad. The casts the only form in which the species is definitely known are readily separable from those of the latter by the posteriorly inclined rather than the vertical sulcus produced by the internal rib.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collections.—Maryland Geological Survey, New Jersey Geological Survey.

Outside Distribution.—*Monmouth Formation.* Red Bank sand, New Jersey.

Superfamily MACTRACEA

Family MACTRIDAE

Genus SPISULA Gray

[Mag. Nat. Hist., n. s. vol. 1, 1838, p. 372]

Type.—*Mactra solida* Linné.

" Shell small, subequilateral, trigonal, with a thin epidermis, adjacent beaks and concentrically grooved dorsal areas; pallial sinus small, rounded; gape obsolete; valves convex; ligament sagittate, set in a callous area close to the dorsal margin and not set off from the chondrophore by any shelly ridge; dental armature normal, strong, not concentrated; the opposed surfaces of the laterals transversely grooved; left cardinal small, prominent, with a small posterior accessory lamella, the posterior ends of both projecting over the chondrophore; right cardinal with the arms coalescent above, the anterior arm close to the dorsal shell-margin; hinge plate thick and flattish; exterior smooth or concentrically striated; the dorsal areas ill-defined."—Dall, 1898.[1]

The absence of a shelly lamina between the chondrophore and the ligament separates *Spisula* from *Mactra.* Furthermore, the laterals of the

Etymology: *Spissus*, thick.

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. iv, p. 878.

latter are smooth or finely granular, while those of the former are, as a rule, transversely striated.

The genus extends well back into the Cretaceous, and, though not abundantly represented in the recent seas, its occurrence is almost universal.

Subgenus CYMBOPHORA Gabb[1]

Type.—Mactra ashburneri Gabb.

"The hinge is composed of a rather heavy hinge plate, bearing a cartilage-pit, not sunk into its substance, as in the others of the *Mactridæ,* but, as it were, built up on its surface; a small, delicate, spoon-shaped process, laid obliquely under the beaks, its base being on, or slightly above the level of the hinge plate; in the right valve the cardinal tooth is single, very delicate, and nearly at a right angle with the anterior wall of the cartilage-pit; in the left valve the tooth is V-shaped, entirely separated from the pit, very slender, and articulated between the tooth and the pit of the opposite side; the lateral teeth are large and comparatively very robust."—Gabb, 1869.

"A careful study of the typical species of this group shows that it differs from *Spisula* only in the following features: The attached ends of the resilium were convex instead of flat (as is sometimes seen in recent species), and the margins of the pit are therefore elevated; while the posterior sinus, instead of being (as usually in the later types of *Spisula*) roofed over or filled up with a solid mass of callus at the apex, upon which the ligament is attached, is vacant, so that the ligament was fixed on the convex margin of the pit, or on the side of the ventral lamina, or partly on both, all being very close together. This character would seem to be trifling until it is observed that all the Mesozoic species are characterized by this feature, though, as in recent *Spisula,* the external form may vary, the dorsal areas be smooth or grooved, the teeth sulcate or smooth. As it is common to all the Cretaceous *Mactridæ* of which I have been able to examine a hinge, I have thought it best to retain the name in a subgeneric sense for that stage of development of the group."—Dall, 1898.[2]

[1] Geol. Survey of California, 1869, Pal., vol. ii, p. 180.
[2] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. iv, p. 879.

The group is restricted to the Cretaceous.

A. Latitude of adult shell rarely exceeding 25 mm.; outline ovate-trigonal .... *Cymbophora berryi*
B. Latitude of adult shell exceeding 25 mm.; outline high-trigonal. *Cymbophora wordeni*

SPISULA (CYMBOPHORA) BERRYI n. sp.

Plate XLIII, Figs. 2, 3

Description.—Shell very thin and fragile, rather small for the genus, transversely ovate-trigonal in outline, smoothly inflated; umbones small but rather prominent, evenly rounded, overtopping the dorsal margin, the apices incurved and feebly prosogyrate, medial or slightly anterior in position; umbonal angle usually exceeding 90°; dorsal margins oblique or somewhat convex, the anterior slope as a rule a little more gentle than the posterior; anterior extremity rather narrow but symmetrically rounded; posterior obscurely truncate obliquely; base line quite strongly and symmetrically arcuate; external surface sculptured with faint, incremental striations, less feeble and more crowded toward the ventral and lateral margins; anterior area cut off by a shallow and sublinear depression which persists from the umbones to the base; incremental sculpture much less feeble in front of the sulcus than behind it; posterior area evenly rounded but differentiated by a linear liration which margins a cuneate area; area clearly differentiated by the very fine evenly crowded concentric striæ; incrementals behind this oblique wedge the most elevated of any on the shell; resilium lodged in a spoon-shaped chondrophore beneath the umbones, posteriorly directed, its margins raised and quite strongly reinforced; hinge armature rather concentrated, two cardinals in the right valve, partially fused beneath the umbones and diverging at an angle of little less than 90°, anterior arm very close to the dorsal margin and diverging from it at a very small angle, posterior arm at the margin of the chondrophore; laterals double, the dorsal lamina distinct from the dorsal margin though fused with it basally; inner faces of clasping laterals transversely striated; left cardinal short but heavy, Λ-shaped; left laterals double, the inner laminæ elevated and flattened upon their summits, transversely striated; adductor muscle scars rather small and

obscure; pallial sinus linguiform, symmetrically rounded, obliquely ascending not reaching the median vertical of the shell.

Dimensions.—Altitude 15 mm., latitude 21 mm., diameter 10.2 mm.

Type Locality.—Brightseat, Prince George's County.

Cymbophora berryi is characterized by its rather small size, evenly inflated valves and regular ovate-trigonal outline.

This prominent member of the Monmouth fauna is named for Prof. Edward W. Berry of Johns Hopkins University.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, 1 mile west of Friendly, 2 miles south of Oxon Hill, Fort Washington, Prince George's County.

Collection.—Maryland Geological Survey.

SPISULA (CYMBOPHORA) WORDENI n. sp.

Plate XLIII, Figs. 4, 5

Description.—Shell rather large, not very thin but very fragile, trigonal in outline, moderately inflated; umbones submedial, well rounded, the apices full, incurved, prosogyrate; umbonal angle not far from 90°, dorsal margin very steep, the anterior oblique, the posterior feebly convex; maximum latitude of shell very near the ventral margin; lateral margins very short, squarely truncate; ventral margin feebly but evenly arcuate; both anterior and posterior areas cut off by obtusely angulated carinæ, the anterior outlined by a linear sulcus, the posterior by an irregular raised line which marks the anterior boundary of a roughened area which originates at the umbones and gradually widens so that its wider extremity is coincident with the posterior lateral margin; anterior area and posterior portion of posterior area quite sharply sculptured incrementally; sculpture on medial portion of disk restricted to rather inconspicuous and irregular incrementals; hinge armature rather concentrated, the hinge plate extending less than half-way down the margin; ligament internal, lodged in a scoop-shaped chondrophore with very strongly upcurved edges; right cardinals diverging at an angle of a little less than 90°, fused at the umbonal extremity of the anterior dorsal margin; lateral laminæ

double, the dorsal plate probably discrete in the young but larger and fused with the dorsal margin in the adults; left cardinal $\wedge$-shaped, placed directly in front of the chondrophore; lateral laminæ prominent, the anterior shorter and more elevated than the posterior, both of them flattened upon their summits and striated transversely; adductor muscle scars obscure, the anterior broadly lenticular and falling below the median horizontal, the posterior larger and rudely quadrilateral; pallial line very near the base; sinus short, uniform in width throughout its extent, obliquely ascending and rounded at its extremity, not attaining the median vertical.

Dimensions.—Altitude 31.5 mm., latitude 37 mm., semi-diameter, 11.5 mm.

Type Locality.—Brightseat, Prince George's County.

This species is well characterized by its high trigonal outline and obtusely angulated anterior and posterior carinæ. The species was at first mistaken for *C. appressa* Gabb from Pataula Creek, Georgia, but it is readily separable, whenever interiors can be obtained, by the transversely striated laterals. It is named for Stanley Worden, who has so greatly assisted in the study of the Upper Cretaceous mollusca.

Occurrence.—MONMOUTH FORMATION.—Brightseat, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly, ? McNeys Corners, Prince George's County.

Collection.—Maryland Geological Survey.

Superfamily MYACEA

Family CORBULIDAE

Genus CORBULA Bruguière

[Encyclopédie Méthodique, 1792, pl. ccxxx]

Type.—*Corbula gallica* Lam.

Shell small, thick, ovate, more or less rostrate; valves unequal, the left usually the smaller and the flatter; umbones prominent, prosogyrate or erect, the right usually higher than the left; hinge line of right valve fitted with a single prominent tooth in front of the resilial pit; lateral laminæ

Etymology: ***Corbula*****, a little basket.**

absent; left valve with a deep cardinal socket and a rudimentary posterior tooth; surface sculpture variable, often discrepant on the two valves of the same individual, usually concentric, never strongly radial; adductor scars distinct; pallial line indistinct; sinus feeble or obsolete.

A prominent genus among the small bivalves since the beginning of the Mesozoic. The recent *Corbulæ* include some seventy species of almost universal distribution but more prolific in the warmer waters, particularly in the China seas.

The *Corbulæ* of the Upper Cretaceous of the East Coast and Gulf are sadly in need of revision. Many of the species have been described from casts and have a doubtful right to stand. The Tertiary and recent *Corbulæ* are so difficult to determine with any degree of assurance, even with all their characters preserved, that it seems farcical to attempt to make accurate specific separations from casts of the interior, excepting in unusually well characterized species, such as *C. bisulcata* Conrad.

A. Area within the pallial line conspicuously inflated...... *Corbula bisulcata*
B. Area within the pallial line not conspicuously inflated.
  1. Valves very strikingly dissimilar, right valve highly inflated, very coarsely plicated concentrically.. *Corbula crassiplica*
  2. Valves not very strikingly dissimilar.
    a. Radial sculpture absent.
      i. Latitude of adult shell exceeding 9 mm., concentric sculpture fine, sharp, crowded. *Corbula monmouthensis*
      ii. Latitude of adult shell not exceeding 9 mm., concentric sculpture more or less obtuse.
        a′. Valves not conspicuously compressed. Concentric plications exceeding 25 in number. *Corbula terramaria*
        b′. Valves conspicuously compressed. Concentric plications not exceeding 25 in number. . *Corbula percompressa*
    b. Radial sculpture present upon the disk in the form of faint linear striations................ *Corbula subradiata*

CORBULA BISULCATA Conrad

Corbula bisulcata Conrad, 1875, Kerr's Geol. Rept. of North Carolina, App., p. 11, pl. ii, figs. 13, 14.

Corbula foulkei Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 180, pl. xxiii, figs. 27-29. (Not *C. foulkei* Lea.)

Corbula bisulcata Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 638, pl. lxxii, figs. 15-22.

Description.—" Shell ovate-acute, equilateral, concentrically striated, with two or three distant large concentric furrows; posterior extremity acute."—Conrad, 1875.

Type Locality.—Snow Hill, North Carolina.

" The dimensions of a partially restored specimen, a plaster cast taken from a natural mould, are: Length 13.5 mm., height 8 mm., thickness 6.5 mm. Shell subcuneate behind, full and rounded in front. Beaks small, incurved, situated back of the middle, pointing posteriorly. Antero-cardinal margin long, straight near the beaks and curving gently downward in front, subparallel with the basal margin; anterior margin regularly rounded; basal margin nearly straight, curving upward in front; postero-basal extremity angular; post-cardinal margin concave. Valves strongly ventricose in front, compressed behind, the ventral margin of the right valve overlapping that of the left and its posterior extremity more produced, beaks of the two valves subequal; an angular umbonal ridge is present on the right valve, with a narrow, slightly concave post-umbonal slope; on the left valve the umbonal ridge is obsolete. Surface of the valves marked by rather fine, concentric lines of growth.

" Perfect internal casts are subcuneate, but not so greatly produced posteriorly as the shells, the muscular impressions are conspicuous, the whole area of the casts between the muscular impressions and the pallial line being strongly inflated. Johnson states that the specimens from Haddonfield, which were illustrated by Whitfield as *C. foulkei,* are not that species but *C. bisulcata* Conrad. An examination of the type specimens in the collection of the Philadelphia Academy of Natural Sciences has confirmed the statement of Johnson. The species occurs in abundance in the Cliffwood clays, and it seems to be one of the most characteristic species in the fauna of that horizon. They occur usually in the form of internal casts, some of which are very perfect, and some good moulds of the exterior have been found."—Weller, 1907.

The species is represented in Maryland by a single cast apparently of an immature individual.

Occurrence.—MATAWAN FORMATION. Three-quarters of a mile southeast of Ulmstead Point, Anne Arundel County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Magothy Formation.* Cliffwood clay, New Jersey. *Matawan Formation.* Merchantville clay marl, Woodbury clay, New Jersey. *Black Creek Formation.* Snow Hill, North Carolina.

CORBULA CRASSIPLICA Gabb

Plate XLIII, Figs. 6, 7

Corbula crassiplica Gabb, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 394, pl. lviii, fig. 25.

Corbula crassiplicata Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 15.

Corbula crassiplicata Conrad, 1868, Cook's Geol. of New Jersey, p. 727.

Corbula perbrevis Conrad, 1875, Kerr's Geol. of North Carolina, App., p. 11, pl. ii, fig. 5.

Corbula crassiplica Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 178, pl. xxiii, fig. 30.

Corbula crassiplica Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 17.

Corbula crassiplica Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 641, pl. lxxii, figs. 27, 28.

Description.—" Subtriangular, heavily ribbed, thick; beaks large and incurved; umbones large and round; umbonal ridge small and marked by a distinct groove immediately in advance of it, rest of the shell marked by about a dozen very coarse transverse ribs except on the umbones which are smooth apparently from attrition. Inside hinge large, caudal prolongation marked by two pit-like depressions. Length .15 in., width .2 in., height of right valve .07 in."—Gabb, 1860.

Type Locality.—" From a cut on the Memphis and Charleston R. R., where it crosses the Tennessee and Mississippi State Line."

Shell small, high, trigonal, slightly inequilateral, very conspicuously inequivalve; right valve almost as high as it is wide, strongly inflated in the umbonal region, the apices incurved, acute, prosogyrate and placed a little in front of the median vertical; left valve oblong trigonal in outline, the altitude usually less than three-fourths of the latitude, the shell evenly inflated and the umbones rather low and subcentral; anterior dorsal and lateral margins of both valves evenly rounded, posterior dorsal

margin oblique, much more produced in the right valve than in the left; lateral margin obliquely truncate; base line broadly and evenly rounded in the left valve, quite strongly arcuate in the anterior portion of the right but feebly constricted in front of the posterior keel, which extends in the form of a sharply elevated ridge from the umbonal region to the posterior basal margin; area behind the keel sharply differentiated from that in front of it, its lateral margin in the right valve thin and slightly reflected; external surface of right valve corrugated with fifteen to twenty prominent concentric plications about half of which are confined to the umbonal region and become increasingly fine and sharp toward the apices, the other half very coarse and heavy, often somewhat irregular in size and spacing toward the base, but approximately uniform in prominence from the anterior margin to just in front of the posterior keel where they abruptly evanesce; keel and area behind it sculptured only with strong incrementals; left valve smooth excepting for irregular incremental sculpture; ligament internal, supported by a rather prominent lamelliform chondrophore in the left valve; resilial pit in right valve quite profound; dentition restricted to a single, subumbonal, sharply conical tooth in the right valve and a subumbonal socket for its reception in the left; adductor scars not very distinct, quite well up toward the dorsal margins, pallial sinus broad but not very deep, pallial line much more distant from the base in the right valve than in the left, because of the overlapping ventral margin of the larger valve.

Dimensions.—Right valve, latitude 5 mm., altitude 4 mm.; left valve, latitude 3 mm., altitude 2.7 mm.; maximum diameter of double valves 2.5 mm.

This species is by far the most abundant representative of the genus in the Upper Cretaceous faunas of Maryland, and is one of the most prolific of the smaller bivalves in the Monmouth of Prince George's County. It is readily recognizable by the strong discrepancy of the valves in size, outline and sculpture and by the robust concentric plications upon the disk of the right valve.

Weathered individuals of this species present a most deceptive appearance; the entire external sculpture and posterior keel and area are decor-

ticated, leaving a high, trigonal subequilateral shell with no trace of concentric plications or posterior keel.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, 1 mile west of Friendly, McNeys Corners, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—Matawan Formation. Merchantville clay marl, Woodbury clay, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, Red Bank sand, New Jersey. *Black Creek Formation.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, Prentiss County, Mississippi. *Mortoniceras* subzone, Stewart County, Georgia. *Ripley Formation. Exogyra costata* zone, Schley County, Georgia; Eufaula, Alabama; Union, Tippah and Alcorn counties, Mississippi. *Extreme top of zone,* Pataula Creek, Georgia.

CORBULA MONMOUTHENSIS n. sp.

Plate XLIV, Figs. 4-8

Description.—Shell rather large for the genus, ovate trigonal in outline, inequilateral and inconspicuously inequivalve; umbones subcentral in position, subequal in the two valves, somewhat flattened upon their summits, the apices acute and prosogyrate; right valve more inflated than left in the anterior portion, and with a wider posterior area which is angulated near its dorsal margin and slightly reflected over the left valve; anterior margins of both valves broadly and evenly rounded; posterior dorsal slope more gentle in the right valve than in the left; the lateral margin produced and obtusely angulated in the right, obliquely truncate in the left; base line more strongly arcuate in the larger valve; external sculpture in both valves of very fine, sharp lamellæ closely overlapping, the free edges directed toward the umbones, least feeble on the anterior and ventral portions of the disk, very faint in the umbonal region and evanescent near the posterior keel; ligament internal, supported by a rather inconspicuous lamelliform chondrophore behind the umbone in the left

valve; resilial pit in the right valve broad but rather shallow, the solitary tooth subumbonal in position, stout, obtusely conical; receiving socket in left valve also subumbonal, long but not very deep; adductor muscle scars relatively long, rather indistinct; pallial sinus broad, shallow; pallial line rather near the basal margin.

Dimensions.—Altitude 6.9 mm., latitude 11.4 mm., maximum diameter of double valves 5 mm.

This is the largest of the *Corbulæ* in the Maryland Cretaceous.

Occurrence.—MONMOUTH FORMATION. Brooks estate near Seat Pleasant, Prince George's County.

Collection.—Maryland Geological Survey.

CORBULA TERRAMARIA n. sp.

Plate XLIII, Figs. 8-10

Description.—Shell rather small, moderately inflated, ovate-trigonal in outline, inequilateral, inequivalved; medial and posterior ventral margins and the posterior lateral margins overlapping; anterior ends broadly rounded in both valves; posterior keel more produced in the right valve, the area behind it wider than in the left and obtusely angulated near the dorsal margin; base line in the right valve quite strongly arcuate anteriorly and medially, recurved and slightly contracted toward the posterior keel; in the left valve feebly and somewhat obliquely arcuate; umbones not very prominent, of equal altitude in both valves, flattened upon their summits, incurved and prosogyrate; posterior area cut off by a sharply rounded ridge which extends from the apices to the posterior basal line; external surface of both valves sculptured with about thirty rounded obtuse concentric ridges, which are strongest upon the disk but which persist with diminished strength across the posterior area, growing gradually finer and closer toward the umbones; ligament internal, supported by a chondrophore in the left valve, which judging by the resilial pit in the right is rather small; cardinal tooth in right valve stout and conical, subumbonal in position; adductor impressions distinct, the anterior a little ventral and the posterior a little dorsal to the median horizontal; pallial

sinus very shallow; pallial line rather distant from the base; body cavity deeply excavated.

Dimensions.—Of double valves: Altitude 4.2 mm., latitude 6.4 mm., maximum diameter 2.8 mm. Right valve of a second specimen: Altitude 5 mm., latitude 6.9 mm.

Type Locality.—Brightseat, Prince George's County.

Occurrence.—MONMOUTH FORMATION. Brightseat, ? Friendly, Prince George's County.

Collection.—Maryland Geological Survey.

CORBULA PERCOMPRESSA n. sp.

Plate XLIV, Figs. 1-3

Description.—Shell small, ovate-trigonal, both valves strongly and almost equally compressed, slightly inequilateral, very slightly inequivalve; umbones subcentral, much flattened upon their summits, prosogyrate; lunule feebly defined, less so in the left valve than in the right; anterior end rather narrow, the dorsal slope moderately steep for the genus; lateral margin evenly but strongly rounded; posterior dorsal slope a little steeper than the anterior; lateral margin obliquely truncate; base line gently arcute and in the right valve very feebly contracted in front of the keel; posterior keel acute and persistent from umbones to base, but not very conspicuous because of the compression of the valves; external surface sculptured with about twenty broad but not greatly elevated concentric plications, which become increasingly finer and more crowded toward the umbones, and which override the keel and persist to the posterior dorsal margin but with diminished vigor; ligament internal; chondrophore, judging by the resilial pit in the right valve, quite narrow but considerably produced; right cardinal tooth rather small; adductor scars rather small, the posterior placed well up under the dorsal margin: pallial sinus very shallow, pallial line distant from the base.

Dimensions.—Altitude 4.4 mm., latitude 6 mm., diameter of double valves 2.3 mm.

Type Locality.—Brightseat, Prince George's County.

C. percompressa is separated from *C. terramaria* by the much higher compression of the valves and the fewer and coarser concentric plications.

Occurrence.—MONMOUTH FORMATION. Brightseat, ? Brooks estate near Seat Pleasant, Prince George's County.

Collection.—Maryland Geological Survey.

CORBULA SUBRADIATA n. sp.

Plate XLIV, Figs. 9-15

Description.—Shell of medium size, rather thin, ovate-trigonal in outline, moderately inflated, inequilateral, inequivalve, right valve slightly overlapping the left along the posterior half of the base line and the dorsal and posterior lateral margins; anterior ends of both valves broadly rounded; posterior end obliquely truncate; ventral margin arcuate in the right valve and feebly contracted in front of the rostrum, slightly patulous anteriorly in the left valve; umbones of equal altitude, moderately inflated, flattened upon their summits, incurved, prosogyrate; posterior keel developed along a line extending from the umbones to the posterior ventral margin, the angulations becoming increasingly acute toward the base; posterior area slightly wider in the right valve than in the left and slightly depressed, obtusely angulated near the dorsal margin of the right valve; external surface sculptured with fine and irregular concentric undulations which sharpen toward the ventral margin but evanesce toward the umbones and are absent altogether upon the posterior area, excepting near the base; concentric sculpture overridden by microscopically fine radial striations developed only upon the disk and at the ventral margin of the posterior area; ligament internal, supported by a laminar chondrophore in the left valve; resilial pit in the right valve broad and shallow; cardinal tooth in right valve stout, conical; adductor muscle scars obscure; pallial sinus broad but very shallow.

Dimensions.—Altitude 4.5 mm., latitude 6.5 mm., maximum diameter of double valves 3.2 mm.

Type Locality.—Brooks estate near Seat Pleasant, Prince George's County.

There are a number of valves of uncertain relationships occurring with *C. subradiata* and at nearby localities. Their affinities are undoubtedly with *subradiata,* but whether they are properly referable to the same species, or subspecies or an entirely distinct species, only the collection of further material will establish. They differ from the type in the greater compression of the valves and the consequently more obtuse posterior keel. Some are more sharply sculptured, others less sharply, but there is an aspect of consanguinity about the group that makes it seem probable that they are isolated representatives of an unbroken series.

Occurrence.—Monmouth Formation. Brightseat, Brooks estate, near Seat Pleasant, ? McNeys Corners, ? 1 mile west of Friendly, Prince George's County.

Collection.—Maryland Geological Survey.

Family SAXICAVIDAE

Genus PANOPE Menard

[Mém. Nouveau Gen. Coq. Biv., 1807, p. 31]

Type.—*Panope aldrovandi* Menard.

Shell equivalve, oblong, gaping at both ends; surface smooth or concentrically furrowed; ligament external, conspicuous; a single prominent conical tooth in each valve; pallial sinus deep.

A genus that has been in existence since the close of the Cretaceous, culminated in the Tertiary and is represented to-day by about a dozen species occurring chiefly in cooler waters.

Dall has given the following discussion of the genus:

" This well-known genus, after the exclusion of the Saxicavoid species, forms a very natural group, related to the *Myacidæ* on the one hand and to *Saxicava* on the other. Some pearly forms formerly confounded with it have long been eliminated, and have relations, no doubt, with *Anatinacea.*

" I have had the advantage of an opportunity to study several Pacific Coast forms in life and in their natural surrounding, as well as a very

Etymology: ***Panopea,*** **a sea-nymph.**

large series of our Tertiary species, and also a fair series of most of the recent exotic species. For that reason, perhaps, the following conclusions will have a certain value, which is only derived from a somewhat extended range of observations of the animals themselves.

"All boring mollusks in which the shell has so degenerated that it no longer covers the whole adult animal when retracted are more liable to variation in minute details than those in which the valves meet distally, and dynamically influence their own development by fixing for it certain definite limits. This is markedly the case in the present genus. Those shells which live in an easily movable medium, such as sand or fine, soft mud, are thinner, better developed, more elongated and less distorted than their cogeners who are obliged to confine themselves to a gravelly or stony situs. So marked is the difference that I have several times been presented with supposed new species based on these dynamic characters, and by a curious reversal of logic, have been assured that the differences must be specific, because the animals inhabited, respectively, the different kinds of ground alluded to.

"I have observed, also, that where the ground into which the burrowers retire is a comparatively thin coating over a stony or rocky layer which they cannot pierce, the tendency in *Panopea, Mya,* etc., is for relatively short and broad shells, with shorter siphons, to survive; which naturally have a wider, shorter, and more rounded pallial sinus and shorter and more incurved nymphs. I believe the influence of the environment is direct and not selective; at all events, the association of situs and specimens so characterized is, as far as I have been able to determine, quite uniform, whether selective or not. . . . .

"In addition to the differences more or less evidently due to situs there is a series of differences which occur among specimens of a single species from apparently the same situs, both in the fossil and recent forms. These include a nearly rectilinear as compared with an arcuate hinge line, and a short as opposed to a long insertion of the ligament. The length of the ligament is perhaps co-ordinated with the heaviness of the valves, but the differences alluded to occur so constantly that I have been led to suspect

that they might be due in part to differences correlated with sex in this genus."—Dall, 1895.[1]

A. Posterior lateral margin obliquely truncate.
  1. Umbones anterior; anterior dorsal margin gently sloping. *Panope decisa*
  2. Umbones subcentral; anterior dorsal margin approximately straight .... *Panope monmouthensis*
B. Posterior dorsal margin smoothly arcuate .... *Panope bonaspes*

PANOPE DECISA Conrad

Panopœa decisa Conrad, 1853, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. ii, p. 275, pl. xxiv, fig. 19.

Panopœa decisa Meek, 1864, Check List Inv. Fossils N. A., Cret. and Jur., p. 15.

Glycymeris decisa Conrad, 1868, Cook's Geol. of New Jersey, p. 727.

Panopea decisa Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 181, pl. xxiv, figs. 5-8.

Panopea decisa Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 18.

Panopea decisa Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 646, pl. lxxiii, figs. 3, 4.

Description.—" Oblong, ventricose, concentrically waved or furrowed; slightly contracted posteriorly; posterior hinge line nearly parallel with the base; posterior margin truncated obliquely inwards; basal margin nearly straight; beaks situated about one-third the shell's length from the anterior margin."—Conrad, 1853.

Type Locality.—? Burlington County, New Jersey, or ? Chesapeake and Delaware Canal, Delaware.

" Shell moderately large and ventricose, with moderately large projecting beaks, which are situated a little nearer the anterior end. widely gaping at the posterior end and closed anteriorly. Anterior extremity rounded, longest below the middle, anterior end truncated, projecting near the cardinal line and receding below. Surface of the shell marked by very strong, broad, concentric undulations most strongly developed on the middle of the valves and becoming nearly obsolete on some specimens both anteriorly and posteriorly. The valves are also often depressed along the posterior umbonal slope, showing a distinct furrow at the bending of the undulations of the surface at this point.

[1] Trans. Wagner Free Inst. Sci., Phila., vol. iii, pt. iii, p. 827.

"The internal features of the species are not easily made out from the imperfect casts under examination, the shell having been too fragile to leave the impressions of pallial line or muscular scars so as to be traced with any degree of certainty. The hinge, however, has been considerably thickened and has left the imprint of its features on some of the specimens, so that by the use of gutta-percha its features have been fairly shown. There is positive evidence of only a single projecting tooth in each valve, which has been long and incurved."—Whitfield, 1885.

The shell is represented in the area under discussion only by a single cast collected from along the canal, one of Conrad's original localities.

It differs from *Panope monmouthensis* in the more compressed valves, the more prominent and more anterior umbones and the more oblique anterior dorsal margin.

Occurrence.—MATAWAN FORMATION. Post 105, Chesapeake and Delaware Canal, Delaware.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, Woodbury clay, Wenonah sand, New Jersey. *Monmouth Formation.* Navesink marl, Red Bank sand, New Jersey. *Peedee Formation.* North and South Carolina. *Eutaw Formation* (Tombigbee sand member). *Exogyra ponderosa* zone, Prentiss County, Mississippi. *Ripley Formation. Exogyra costata* zone, Warrior County, Georgia; Owl Creek, Tippah County, Mississippi.

PANOPE MONMOUTHENSIS n. sp.

Plate XLV, Figs. 4, 5

Description.—Shell large, subcylindrical in outline, inequilateral, gaping posteriorly, apparently closed in front; umbones subcentral, not very prominent; dorsal margins straight; anterior lateral margin broadly rounded, or obscurely truncate, posterior obliquely truncate from the dorsal margin to the ventral so that the former margin is more produced posteriorly than the latter; base line approximately straight and parallel to

the cardinal margins, rounding smoothly into the anterior lateral margin and more abruptly into the posterior; external surface undulated concentrically, rather sharply and regularly in the immediate vicinity of the umbones, broadly and irregularly over the medial portion and more closely toward the ventral and lateral margins; ligament external, opisthodetic, mounted on a short but very robust nymph; no hinge plate developed, armature restricted to a single cardinal tooth in each valve, the cardinal of the right valve in front of that of the left when interlocked; characters of muscle scar and pallial line unknown.

Dimensions.—Altitude 65.6 mm., latitude 100.5 mm., semi-diameter 19 mm.

Type Locality.—Brightseat, Prince George's County.

The form differs from Conrad's *decisa* in being more compressed, with less prominent, more central umbones and a more constricted anterior dorsal margin.

Occurrence.—MONMOUTH FORMATION. John Higgins farm, 2 miles west of Delaware City, Delaware; ? Cayots Corners, Cecil County; Brightseat, Brooks estate near Seat Pleasant, ? McNeys Corners, Prince George's County, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

PANOPE BONASPES n. sp.

Plate XLV, Fig. 2

Description.—Shell rather small, elliptical in outline, almost twice as high as wide, moderately and evenly inflated; umbones compressed; subcentral, overtopping the dorsal margin; anterior portion of shell symmetrically rounded, the posterior slightly wider and more broadly arcuate; base line approximately straight; external surface sculptured with irregular, concentric corrugations which are most pronounced on the medial dorsal and posterior portions of the shell, evanescing anteriorly and broader and more shallow ventrally; characters of interior of shell not known.

Dimensions.—Altitude 26 mm., latitude 49 ± mm.; semi-diameter 8 mm.

Panope bonaspes is smaller than either of the other *Panopeæ* represented within the area under discussion and differs from them both in the smoothly rounded rather than obliquely truncate posterior margin.

The species is perhaps the most conspicuous member of the Magothy bivalve fauna.

Occurrence.—MAGOTHY FORMATION. Good Hope Hill, District of Columbia.

Collection.—Maryland Geological Survey.

Superfamily ADESMACEA

Family PHOLADIDAE

Genus PHOLAS Linné

[Systema naturæ, ed. x, 1758, p. 669]

Type.—*Pholas dactylus* Linné.

Shell thin, brittle, often strengthened externally by accessory plates, elongate, cylindrical, gaping anteriorly; valves reflected at the umbones, the space beneath divided by radial septa into cellular chambers; hinge plate furnished with myophorial process; sculpture not uniform over the surface of the valve; pallial sinus long and deep as would be inferred from the long siphons which are united excepting at the ciliated extremities.

The genus has been in existence since the Jurassic. It is represented to-day by about twenty species, all of them burrowers in clay, wood or even rock, and all possessing the property of phosphorescence.

PHOLAS PECTOROSA Conrad

Plate XLV, Fig. 1

? ? *Pholas cithara* Morton, 1834, Syn. Org. Rem. Cret. Group, U. S., p. 68, pl. ix, fig. 10.

***Pholas pectorosa* Conrad, 1854, Proc. Acad. Nat. Sci., Phila. for 1852-53, p. 200.**

Etymology: φωλάς, lurking in a hole.

Pholas pectorosa Conrad, 1854, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. ii, p. 299, pl. xxvii, fig. 9.

? ? *Pholas cithara* Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 16.

? ? *Clavipholas cithara* Conrad, 1868, Cook's Geol. of New Jersey, p. 728.

? ? *Martesia cithara* Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 304.

Pholas cithara Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 187, pl. xxv, figs. 14-16. (Synonymy excluded.)

Pholas pectorosa Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 18.

Pholas cithara Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 651, pl. lxxiv, fig. 7 *(ex parte)*.

Description.—" Ovate-cuneate; anteriorly inflated, contracted in the middle; posterior side cuneiform; disk with radiating ribs, largest anteriorly, and interrupted by concentric furrows; anterior side very short, margin obtusely rounded or subtruncated; basal margin rounded anteriorly, contracted medially, straight posteriorly."—Conrad, 1854.

Type Locality.—Tinton Falls, Monmouth County, New Jersey.

" Shell triangularly ovate, acutely pointed behind and subtruncate in front. Valves very ventricose, the depth and thickness when united about equal, giving a nearly round section. Anterior umbonal ridge inflated and nearly subangular in some cases, always sharply rounded, and the anterior surface somewhat flattened or but little convex. Central region of the valves sulcated obliquely, more or less constricting the front margin at about or just behind the center. Hinge line straight, deeply sunken betwen the large, inflated and enrolled approximate beaks. Surface of the shell marked by strong radiating ribs, numerous but somewhat irregular posterior to the umbonal angle, but few and distant in front; also by comparatively strong concentric ridges, which are distinctly deflected at the mesial sulcus and pass obliquely upward in front of it. These concentric ridges form flattened nodes of the radiating ribs by crossing them on the anterior part of the shell.

" I have seen several casts of this species, and noticed considerable variation in their characters, especially in the strength of the surface markings, in the form of the anterior end, and in the strength of the mesial sulcus of the valves, and especially in the strength and character of a sometimes deeply impressed but narrow line marking the bottom of the sulcus and dividing the anterior and posterior sections of the shell, it

being in some instances almost obsolete. Mr. Morton's type specimen, which I have not seen, seems to have been very small, and to have had the anterior end rounded from below, while Mr. Conrad's type of *P. pectorosa* is full and round below and sloping above, while a cast of a single valve which is figured appears to have been quite sharply truncate in front and angular on the umbonal ridge. There is also much difference in the proportional strength of the two sets of ribs in the different examples."—Whitfield, 1885.

Morton's type of *P. cithara* has, apparently, been lost and his description is so meager and his figure so inadequate that it is impossible to determine with absolute assurance its relationship to the *P. pectorosa* of Conrad. Conrad's type now in the Philadelphia Academy of Natural Sciences is from the Monmouth at Tinton Falls, New Jersey, and there is no doubt whatever about the specific identity of this form and the casts from the Monmouth of Prince George's County. It seems not at all improbable, though by no means established, that Conrad's species is distinct from Morton's and possibly its descendant, since in New Jersey and Maryland the former is restricted apparently to the Monmouth, the latter to the Matawan.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Prince George's County.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey, U. S. National Museum.

Outside Distribution.—Monmouth Formation. Tinton beds, New Jersey. *Ripley Formation. Exogyra costata* zone, ? Chickasaw, ? Union, and ? Tippah counties, Mississippi.

Genus MARTESIA Leach

[Blainville, Man. Mal., vol. 1, 1825, p. 632]

Type.—Pholas clavata Lamarck = *Pholas striata* Linné.

Shell ovate-oblong, cuneiform, strengthened by three accessory plates; young forms gaping anteriorly; valves closed at the completion of the burrow with a calcareous septa or "callum"; surface deeply sculptured by a single radial sulcus.

Etymology: Unknown.

The genus has been reported from deposits as early as the Carboniferous. The customary habitat of the present day species is in burrows excavated in the floating timber and driftwood of the warm and temperate seas.

MARTESIA CRETACEA Gabb

Pholas cretacea Gabb, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 393, pl. lxviii, fig. 18.

Pholas cretacea Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 16.

Pholas ? cretacea Conrad, 1868, Cook's Geol. of New Jersey, p. 728.

Martesia cretacea Gabb, 1876, Proc. Acad. Nat. Sci., Phila., p. 304.

Martesia (Pholas) cretacea Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 190, pl. xxv, figs. 20-23.

Pholas cretacea Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 18.

Martesia cretacea Johnson, 1905, *Ibidem*, p. 18.

Martesia cretacea Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 654, pl. lxxiv, figs. 8-11.

Description.—" Tube conical, rounded at the widest end, surface marked by oblique lines; shell (?)."—Gabb, 1860.

Type Locality.—Raritan Bay, New Jersey.

" Shell small, subhemispherical in front, cuneate behind, the beaks strongly incurved, umbones prominent. The anterior margin rounding regularly from the anterior extremity of the hinge line into the straight basal margin, posterior margin subtruncate, post-cardinal margin sloping backward from the posterior extremity of the hinge line. Surface of each valve marked by a deep, narrow groove extending from the beak obliquely backward to the ventral margin which it meets in front of the middle of the shell; in most individuals a second groove close to and parallel with the first, but a little wider and shallower, is introduced a short distance below the beak and continues to the margin. The anterior region of the shell is marked by fine costæ which bend abruptly upward in front of the oblique grooves, continuing to above the middle of the shell, where they make a nearly rectangular turn and continue in a horizontal direction to the anterior margin, surrounding two sides of, and sharply differentiating, a smooth, triangular, slightly raised area in the antero-ventral region of each valve. The posterior region of the shell is marked by broader. rounded costæ, parallel with the margin of the valves.

"The dimensions of a specimen of average size are: Length 7 mm., height 4.5 mm., greatest thickness 4.8 mm.

"The name *Pholas cretacea* was originally applied to a group of casts of the tubes of one of the *Pholadidæ,* without any knowledge of the shell characters. At a later date the original author of the species described a single individual of a shell and referred it to the same species as the previously described tubes, 'because it is of about the proper size to form such tubes.' In themselves, the tubes of this group of pelecypods possess no characters which can be used for specific determination, and consequently the species *Pholas cretacea,* afterwards referred to the genus *Martesia,* may be considered as founded upon the shell described by Gabb. Whitfield has illustrated Gabb's specimen and redescribed it, but he saw no additional specimens. In the recent collections of the Survey, fifty or more individuals of this species have been observed in a fragment of fossil wood from 1 to 1½ in. in diameter and 8 in. long. The entire surface of this wood is filled with the burrows of this species, and in each burrow is a well preserved shell or the internal cast of a shell. These specimens show some variation in several characters, but a comparison with Gabb's type of *M. cretacea* has shown them to be not essentially different from that species. Some of the examples are shorter than usual and consequently taper more abruptly to the posterior extremity than the average form, but the most important variation is the presence or absence of the supplementary oblique furrow in front of the primary one extending from the beak to the ventral margin. In the majority of individuals this furrow is present and its absence is more apt to be a feature of the smaller and presumably the younger shells. In a few specimens of nearly maximum size this furrow is nearly obsolete, being noticeable only near the ventral margin, and in one specimen it is absent from one valve, although faintly indicated on the other."—Weller, 1907.

The species has a doubtful representation within the Delaware-Maryland area. A single somewhat distorted tube referred tentatively to this species was collected along the canal. A cast of the interior with fragments of the substance still adhering has even more dubious affinities. The surface characters are apparently very similar to those of *M. cretacea,*

but the valves are smaller and so much more compressed that it seems hardly probable that the limits of variation even in *Martesia* are wide enough to include both forms.

Occurrence.—MATAWAN FORMATION. ? Marl pit near Post 236, Chesapeake and Delaware Canal, Delaware. MONMOUTH FORMATION. ? Brightseat, Prince George's County, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, Marshalltown clay marl, New Jersey.

Family TEREDINIDAE

Genus TEREDO Linné

[Systema Naturae, ed. x, 1758, p. 651]

Type.—*Teredo navalis* Linné.

Shell much reduced; valves trilobed, widely gaping anteriorly and posteriorly; surface concentrically striated; hinge margin reflected, edentulous; spoon-shaped process projecting from interior of hinge for attachment of pedal muscle; anterior adductor degenerate; pallial line coincident with the margins of the valves.

The recent representatives of the species, the so-called ship-worms, have been notorious since the days of the Roman Empire. To-day they occur in the temperate and tropical seas in numbers sufficient to endanger all submarine wooden constructions, whether ships, wharves, piers, bridges, piles or dikes. Protection is gained only by metal sheathing or by treatment with creosote.

The genus has a long pedigree. Certain burrows from the Carboniferous have been referred doubtfully to the *Teredo,* and there is no question that it existed in the Mesozoic.

A. Posterior extremity of shell lobate dorsally; tubes circular in cross-section ....*Teredo irregularis*
B. Posterior extremity of shell slightly produced dorsally but not lobate; tubes lenticular in cross-section......................*Teredo rhombica*

Etymology: *Teredo,* a name given by Pliny to a worm that gnaws wood.

TEREDO IRREGULARIS Gabb

Teredo tibialis **Morton, 1834, Syn. Org. Rem. Cret. Group U. S., p. 68** *(ex parte).*

Teredo irregularis **Gabb, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 393, pl. lxviii, fig. 19.**

Teredo contorta **Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jur., p. 16.**

Teredo irregularis **Meek, 1864,** ***Ibidem.***

Teredo contorta **Conrad, 1868, Cook's Geol. of New Jersey, p. 727.**

Teredo irregularis **Conrad, 1868,** ***Ibidem.***

Teredo irregularis **Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 191, pl. xxv, figs. 18, 19.**

Teredo irregularis **Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 18.**

Teredo contorta **Johnson, 1905,** ***Ibidem.***

Teredo irregularis **Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 656, pl. lxxiv, figs. 1-3.**

Description.—" Tube irregular, tortuous, dilated in places and sometimes transversely wrinkled. Shell twice as large as that of *T. tibialis,* more abruptly truncate anteriorly."—Gabb, 1860.

Type Locality.—? New Jersey.

" Tubes as shown by their casts gregarious, exceedingly tortuous and contorted, sometimes annulated, increasing gradually in size from their point of origin, the larger ones reaching a diameter of 10 mm. or more. Shell subglobular, cordate in outline from in front, the beaks a little in front of the middle of the hinge line, widely gaping behind and open in front; the postero-cardinal extremity somewhat produced in a rounded lobe. Anterior margin rounding from the hinge line above into the upper margin of the large, deep, subrectangular, antero-basal hiatus which reaches above the mid-height of the shell; basal margin short; posterior margin obliquely subtruncate below, bent abruptly backward near the hinge line and continuing around the postero-cardinal lobe of the shell. Valves ventricose, the beaks prominent, much elevated above the hinge line and strongly incurved or enrolled; the surface curving steeply towards the antero-cardinal extremity and then deflected shortly before reaching the margin, curving less abruptly to the postero-cardinal extremity. In the casts a very deep and prominent furrow passes from the hinge line just back of the beaks to the posterior margin just below the post-cardinal lobe

of the shell; another faint groove, which is less conspicuous upon the larger individuals, crosses the post-umbonal slope in a nearly vertical direction from the lower margin of the deep groove already described behind the beaks to the posterior extremity of the basal margin; surface of the anterior half of the shell, as shown in impressions of the exterior, marked by exceedingly fine, regular, concentric striæ, parallel with the shell margin, twenty or more of which occupy the space of 1 mm. These striæ towards the antero-cardinal extremity are crossed by finer radiating striæ, which produce an exceedingly fine reticulate pattern upon the shell surface. Markings of the posterior half of the shell unknown.

"Casts of the irregular burrows of this species are sometimes of common occurrence in the Merchantville clay, penetrating masses of fossil wood, and on tracing these burrows to their termination casts of the shell can usually be found, sometimes in excellent condition. Some masses of the tubes are all much smaller than those in other masses, but all the tubes in one group are usually of approximately the same dimensions. It was at first thought possible that the different sized tubes indicated different species, but the shells are all essentially the same, whether from large or small tubes, in all masses observed in the Merchantville clay marl. A mass of essentially identical tubes has been found in the Marshalltown clay marl, however, associated with many individuals of *Martesia bisulcata,* which have a very different shell, described in this report as *Turnus kümmeli.* Other similar tubes occur sometimes in the Navesink marl, but the accompanying shells have not been observed. These tubes, however, seem to be straighter and they probably belong to another species.

"The type specimen of *T. irregularis* is without data as to locality or horizon, and the description of the shell itself is too meager to be of any use in identification. Inasmuch, however, as the Merchantville clay marl is the horizon where burrows of this sort most frequently occur, and as Gabb described numerous fossils from this horizon in Burlington County, New Jersey, it is altogether probable that the type specimen is specifically identical with the shell here described.

"Morton evidently applied the name *Teredo tibialis* to all the *Teredo*-like tubes he found in New Jersey, but the name is still retained for the

tubes like those which he illustrated, which are found only in the Vincentown limesand. The specimens which he referred to from 'the friable marls' which are preserved as 'casts in lignite' were in all probability representatives of the species *T. irregularis.*

"The type of *Teredo contorta* Gabb, which is preserved in the collection of the Philadelphia Academy of Science, has been carefully compared with the recently collected examples which are here referred to *T. irregularis,* and there can be no doubt as to their specific identity; it also is without doubt a Merchantville clay marl specimen, and it is safe to conclude that it is a synonym of *T. irregularis.*"—Weller, 1907.

The species is represented in Maryland only by a few fragmentary tubes, the largest of them embedded in a mass of wood from near Post 218 on the Chesapeake and Delaware Canal.

Occurrence.—MATAWAN FORMATION. Post 218, Chesapeake and Delaware Canal, Delaware; Ulmstead Point, Anne Arundel County, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences, New Jersey Geological Survey.

Outside Distribution.—*Matawan Formation.* Merchantville clay marl, New Jersey.

TEREDO RHOMBICA n. sp.

Plate XLV, Fig. 3

Description.—Shell composed of two small plates gaping widely at both extremities, feebly convex and rhombic in outline; umbones small, rounded, inconspicuous, not overtopping the dorsal margin; anterior dorsal margin horizontal, approximately parallel to the base, slightly produced behind; posterior dorsal margin oblique, diverging from the anterior at an angle of not far from 140°, merging smoothly into the truncated lateral margin; posterior lateral margin obliquely truncate, produced but not lobate at the dorsal extremity; base line straight, less abruptly upcurved behind than in front; posterior area differentiated by a linear sulcus dropped from the umbones to the posterior ventral margin; incremental sculpture in front of the diagonal feeble and irregular, behind it sharp and minutely laminar, the dorsal edges free and closely

and regularly overlapping; ligament obsolete; hinge margin reflected, edentulous; produced under the umbones into a minute linguiform process for the support of the pedal muscle; characters of interior obscure; tubes compressed, corrugated, lenticular in cross-section.

Dimensions.—Altitude 5 mm., latitude 3.2 mm., maximum diameter 4 mm.

The valves are separated from those of the co-existent *Teredo irregularis* Gabb by the non-lobate posterior dorsal extremity, while the tubes differ from the irregular cylindrical tubes of Gabb's species in being compressed and corrugated.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collection.—Maryland Geological Survey.

MOLLUSCOIDEA

CLASS BRACHIOPODA

Order TELOTREMATA

Superfamily TEREBRATULACEA

Family TEREBRATULIDAE

Genus TEREBRATULA Müller (Buckman emend.)

TEREBRATULA HARLANI Morton.

Plate XLVII, Figs. 1-5

Terebratula harlani Morton, 1829, Am. Jour. Sci., 1st ser., vol. xvii, p. 283; vol. xviii, p. 250, pl. iii, fig. 16.
Terebratula harlani Morton, 1827, Jour. Acad. Nat. Sci., Phila., 1st ser., vol. vi, p. 73, pl. iii, figs. 1-7.
Terebratula perovalis Morton, 1827, *Ibidem*, p. 77, pl. iii, figs. 7, 8. (Not *T. perovalis* Sowerby.)
Terebratula harlani Morton, 1834, Syn. Org. Rem. Cret. Group, U. S., p. 70, pl. iii, fig. 1, pl. ix.
Terebratula camilla Morton, 1834, *Ibidem*, p. 70.
Terebratula harlani Marcou, 1853, Expl. Text to Geol. Map U. S. and British Provinces of N. A., p. 47, pl. vii, fig. 8.
Terebratula harlani Gabb, 1862, Proc. Acad. Nat. Sci., Phila., for 1861, p. 18.
Terebratula harlani Cook, 1868, Cook's Geol. of New Jersey, p. 375, text figs.
Terebratula harlani Conrad, 1868, *Ibidem*, p. 723.
Terebratula harlani Credner, 1870, Zeitsch. Deutsch. Geol. Gesell., vol. xxii, p. 221.
Terebratula harlani Whitfield, 1885, Mon. U. S. Geol. Survey, vol. ix, p. 6, pl. i, figs. 15-23.
Terebratula gorbyi Miller, 1892, 17th Ann. Rept. Dept. Geol. and Nat. Res. Indiana, p. 687, pl. xiii, figs. 3, 4.
Terebratula harlani Bagg, 1898, Am. Geol., vol. xxiii, p. 370.
Terebratula harlani Clark and Martin, 1901, Maryland Geol. Survey, Eocene, p. 204, pl. lviii, figs. 2, 3.
Terebratula harlani Johnson, 1905, Proc. Acad. Nat. Sci., Phila., p. 6.
Terebratula harlani Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 357, pl. xxviii, figs. 1-8.

Description.—" Shell large, about twice as long as broad, sides straight and imperfectly parallel; upper valve plano-convex, obscurely biplicated except near the margin, which has three inconsiderable sinuses; lower

valve very convex, with a longitudinal ridge and slight lateral depressions; beak incurved; umbo prominent."—Morton, 1829.

"Shell large, the dimensions of a large individual being: Length 59 mm., width 36 mm., thickness 36 mm.; elongate oval in outline with subparallel sides, often becoming more or les cylindrical in old specimens; the front margin more or less truncated, sometimes bilobate from a flattening or lobing of the valves anteriorly. Pedicle valve very ventricose, becoming almost gibbous in old individuals, the beak large, strong, incurved, truncated at the apex by the large foramen whose diameter is greater externally than within, the truncation in full-grown shells being parallel with the axis of the valves; lateral margins of the beak subangular; the median portion of the valve often flattened or somewhat concave toward the front and the lateral slopes sometimes impressed. Brachial valve much less convex than the pedicle, the beak small and strongly incurved; the median portion of this valve flattened or concave anteriorly, the flattened portion being bounded on each side by a more or less distinct angular ridge which separates it from the lateral slope, this feature often being exaggerated to so great an extent as to give the anterior half of the shell a decidedly plicate apearance; internally the crura are slender near the junction with the valve, and expand rapidly to form a broad loop from 8 mm. to 15 mm. in length, with the width more than two-thirds of the length, the loop sharply angular at the points of recurvature. Surface of both valves marked by numerous lines of growth which are often crowded towards the front of old specimens so as to form distinct varices. Shell substance finely punctate, the punctæ usually visible under a hand lens, always more distinctly seen upon exfoliated surfaces.

"Remarks.—This species is perhaps the largest Terebratuloid shell known in any of the American faunas, and at the horizons where it is found in the Cretaceous formations of New Jersey it usually occurs in great numbers. It usually forms a very constant bed at the summit of the Hornerstown marl where, through several feet of sediments, the shells occur almost to the exclusion of everything else. The species also occurs in the quartz sand facies of the Vincentown formation, sometimes in great numbers, but always in the form of internal casts."—Weller, 1907.

The young are much broader relatively than the adults. None of the Maryland individuals that have come under observation exhibit the strong radial plication which characterizes the variety *fragilis*. There is scarcely an individual which is less feebly plicate than Morton's type of *T. harlani*, sensu stricto.

The species occurs associated with the Eocene, and quite a little literature has grown up around the question of whether or not the species is reworked.

Occurrence.—RANCOCAS FORMATION. Drawyer Creek, near Odessa, south side of Appoquinimink Creek between Odessa and mill-dam, Noxonville, Noxontown Millpond, Delaware; head of Sassafras River on Jackson farm and Jacobs farm, Maryland.

Collections.—Maryland Geological Survey, Philadelphia Academy of Natural Sciences.

CLASS BRYOZOA

Order CYCLOSTOMATA

Family DIASTOPORIDAE

Genus STOMATOPORA Bronn

STOMATOPORA REGULARIS Gabb and Horn

Plate XLVI, Fig. 11

Stomatopora regularis Gabb and Horn, 1862, Jour. Acad. Nat. Sci., Phila., (2) vol. v, p. 172, pl. xxi, fig. 63.

Stomatopora regularis Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 313, pl. xx, figs. 1-3.

Alecto regularis Meek, 1864, Check List Inv. Fossils, N. A., Cret. and Jurassic, p. 4.

Description.—" Zoarium encrusting, ramose, the branches filiform and usually very regular, from 0.4 mm. to 0.6 mm. in width, the surface slightly convex, the sides sloping gently towards the lateral margins, rarely or never abrupt. Zoœcia regular in shape, usually a little wider just behind the aperture and the sides converging slightly posteriorly, this difference in width, however, is frequently scarcely noticeable and is never sufficient to sharply separate the successive zoœcia from each other.

Zoœcial apertures circular, tubular and inclined a little forward in unworn specimens."—Weller.

The type specimens were obtained from the Vincentown limesand of the Rancocas formation of New Jersey, where the species occurs quite abundantly.

Occurrence.—RANCOCAS FORMATION. South side of Appoquinimink Creek between mill-dam and Odessa, and at Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

STOMATOPORA KÜMMELI Ulrich and Bassler

Plate XLVI, Fig. 10

Stomatopora kümmeli **Ulrich and Bassler, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 314, pl. xx, fig. 4.**

Description.—Zoarium encrusting, ramose, the branches very fine and delicate, from 0.15 mm. to 0.2 mm. in width, the surface transversely convex, the slope from center to lateral margins never abrupt. Zoœcia regular in form, scarcely differentiated, although the sides converge slightly posteriorly. Zoœcial apertures circular, in unworn specimens, with the rim slightly elevated and inclined a little forward.

This species is a very close ally of *S. regularis,* but may be distinguished from that species by its more delicate growth and smaller zoœcia.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Genus BERENICEA Lamarck

BERENICEA AMERICANA Ulrich and Bassler

Plate XLVI, Fig. 14

Berenicea americana, **Ulrich and Bassler, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 315, pl. xx, fig. 7.**

Description.—Zoarium encrusting, growing in more or less irregular patches upon the surfaces of other bryozoa. Zoœcia contiguously arranged in more or less regular spreading series, each zoœcium about 0.5 mm. in

length and from 0.1 mm. to 0.13 mm. in width, the lateral boundaries sharply defined by impressed grooves, the surface gently convex transversely. Zoœcial apertures nearly terminal, circular, a little narrower than the zoœcia, directed slightly forward, with a slightly elevated rim-like border.

This species cannot be confused with any associated bryozoa, the other American species of the genus being mainly of Ordovician age. The species is particularly characterized by its small, narrow, elongate zoœcia, with each zoœcium sharply marked laterally.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Family IDMONEIDAE

Genus CRISINA d'Orbigny

CRISINA STRIATOPORA Ulrich and Bassler

Plate XLVI, Fig. 15

Crisina striatopora Ulrich and Bassler, 1904, Maryland Geol. Survey, Miocene, p. 406, pl. cxvii, figs. 1-4.

Crisina striatopora, Ulrich and Bassler, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 319, pl. xxi, figs. 15-18.

Description.—Zoarium erect, ramose, probably not exceeding 1 cm. in height, dividing dichotomously at intervals of about 1.5 mm.; branches subovate in cross-section, thickest uniformly convex and traversed longitudinally by from sixteen to twenty punctate striæ on the reverse side, narrower and carrying alternating series of zoœcial apertures on the obverse side. Zoœcial apertures rarely three, usually four in each series, in contact laterally, the inner one of each series largest, most prominent and subcircular, the outer one smallest, drawn out distally and apparently grading into the pores lying between the longitudinal ridges of the reverse side. Series of zoœcia curving first forward then slightly backward, separated by a deep interspace averaging about 0.2 mm. in width; about five rows in 2 mm. Over the basal part of the zoarium the zoœcial apertures are covered one after the other by the growth of the striato-punctate dorsal integument.

The type specimens were obtained from the Miocene of Maryland, but apparently the same species occurs rather rarely in the Vincentown limesand of the Upper Cretaceous at Vincentown, New Jersey.

Occurrence.—RANCOCAS FORMATION. South side of Appoquinimink Creek between mill-dam and Odessa, Delaware.

Collection.—Maryland Geological Survey.

Family FASCIGERIDAE

Genus FILIFASCIGERA d'Orbigny

FILIFASCIGERA MEGÆRA (Lonsdale)

Plate XLVI, Fig. 12

Tubulipora megæra Lonsdale, 1845, Quart. Jour. Geol. Soc., London, I, p. 69, figs. a, b.

Filifascigera megæra Gabb and Horn, 1862, Jour. Acad. Nat. Sci., Phila., (2) vol. v, p. 165, pl. xxi, fig. 53.

Filifascigera megæra Ulrich, 1896, Zittel-Eastman, Textbook Pal., vol. i, p. 263, fig. 421.

Filifascigera megæra Ulrich and Bassler, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 325, pl. xxii, figs. 12-15.

Filifascigera megæra Ulrich, 1913, Zittel-Eastman, Textbook Pal., vol. i, p. 332, fig. 451.

Description.—The encrusting zoarium of this species may very readily be recognized from all cyclostomatous bryozoa by the fasciculate zoœcia, arranged in groups of from two to five, arising from the center of the broadest portions of the zoarium.

This is a common and characteristic species of the Vincentown limesand in New Jersey and Delaware.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Family LICHENOPORIDAE

Genus LICHENOPORA Defrance.

LICHENOPORA PAPYRACEA (d'Orbigny)

Plate XLVI, Fig. 13

Unitubigera papyracea D'Orbigny, 1852, Pal. Franc., Terr. Cret. Tom. 5, p. 761, pl. 643, figs. 12-14.

Lichenopora papyracea Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 27, pl. xxii, fig. 20.

Description.—The small encrusting subcircular colonies of this species with a maximum diameter of 4 mm. readily separates this form from all other associated species.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Order CHILOSTOMATA

Family MEMBRANIPORIDAE

Genus MEMBRANIPORA Blainville

MEMBRANIPORA ANNULOIDEA Ulrich and Bassler

Plate XLVI, Fig. 3

Membranipora annuloidea Ulrich and Bassler, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 335, pl. xxiii, fig. 16.

Description.—Zoarium encrusting. Zoœcia from 0.5 mm. to 0.65 mm. in length, their width about three-fourths their length, more or less hexagonal in outline, sharply defined by depressed furrows. Zoœcial apertures about 0.2 mm. in length, subovate in outline, surrounded by a rather broad, somewhat elevated, rounded marginal rim which is marked by a series of from ten to thirteen small subcircular pits with raised borders. Ovicells variable in their distribution, either abundant or much scattered, usually a little broader than long with the side next the zoœcial aperture somewhat flattened, about 0.15 mm. in width.

When worn, the marginal ring of pits about the zoœcial apertures is more or less obscure and sometimes wanting entirely. The species somewhat resembles the Italian Tertiary species *M. annulus* Manzoni, but differs in having more rounded zoœcia and more numerous pores.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Genus AMPHIBLESTRUM Gray

AMPHIBLESTRUM HETEROPORA (Gabb and Horn)

Plate XLVI, Figs. 5, 6

Reptoflustrella? heteropora Gabb and Horn, 1862, Jour. Acad. Nat. Sci., Phila. (2), vol. v, p. 162, pl. ii, fig. 50.

Reptoflustrella ? heteropora Ulrich, 1901, Maryland Geol. Survey, Eocene, p. 213, pl. lx, figs. 8, 9.

Amphiblestrum heteropora Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, 1907, p. 333, pl. xxiii, figs. 14-16.

Description.—Zoarium encrusting in irregular patches, usually growing upon other species of bryozoa. Zoœcia in a single layer, usually arranged with but little regularity, but sometimes exhibiting a tendency to grow in radiating lines, longer than wide, pointed in front, broadly subtruncate behind; aperture about 0.15 mm. in width, subtriangular in outline with convex sides, often approaching an oval form in very long zoœcia; bordered anteriorly and laterally by a slightly elevated, rounded ridge which becomes obsolete posteriorly. Just in front of the anterior angle of the zoœcial aperture is a small subcircular pore, probably the point of attachment of an avicularium. Posterior portion of the zoœcia covered with a regularly convex, smooth wall, which in old zoaria is continued over the entire surface, totally obliterating the aperture.

Not uncommon in the Vincentown limesand at Vincentown, Mullica Hill and Timber Creek, New Jersey, and at Noxontown Millpond, Delaware. Rare in the Eocene (Aquia) at Upper Marlboro, Maryland.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Genus ESCHARINELLA d'Orbigny

ESCHARINELLA ?? ALTIMURALIS Ulrich and Bassler

Plate XLVI, Fig. 7

Escharinella altimuralis Ulrich and Bassler, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 339, pl. xxiv, figs. 9, 10.

Description.—This very characteristic species may be readily distinguished by its suborbicular zoœcia averaging 0.5 mm. in length with their extremely thin walls and with a very large subelliptical avicularium at each zoœcial angle. The generic placement in *Escharinella* is entirely provisional until this group of species can be thoroughly studied.

This is an abundant species in the Vincentown limesand at Vincentown, New Jersey.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Family CRIBRILINIDAE

Genus CRIBRILINA Gray

CRIBRILINA SAGENA (Morton) Weller

Plate XLVI, Figs. 1, 2

Flustra sagena Morton, 1834, Syn. Org. Rem. Cret. Group, N. A., p. 79, pl. xii, fig. 7.

Escharina ? sagena Lonsdale, 1845, Quart. Jour. Geol. Soc., London, I, p. lxxi, figs. a-c.

Pliophlœa sagena Gabb and Horn, 1862, Jour. Acad. Nat. Sci., Phila. (2), vol. v, p. 150, pl. xx, fig. 34.

Cribrilina sagena Weller, 1907, Geol. Survey, of New Jersey, Pal., vol. iv, p. 34, pl. xxiv, figs. 11, 12.

Description.—Zoarium consisting of rather broad, irregularly branching, more or less tortuous plates composed of several layers of zoœcia superimposed one upon another. Zoœcia in close contact all around, elongate-subelliptical or subquadrangular in outline; from 0.3 mm. to 0.4 mm. in length, the width usually about one-half the length, arranged more or less regularly in longitudinal lines and in quincunx. Zoœcial apertures terminal, small, 0.1 mm. or less in diameter, subcircular or subquadrate in outline; back of the aperture the outer surface of the zoœcia is covered by a thin, nearly flat or slightly convex wall, which is marked by about sixteen straight rows of fine perforations, which extend inward from and at right angles to the margin of the zoœcium. Avicularia small, subcircular or subelliptical in outline, two in number for each zoœcium, situated one on either side of the zoœcial aperture. Ovicells scattered irregularly over the surface of the zoarium, usually not abundant; they are smooth, dome-shaped bodies, considerably larger than the zoœcial apertures just above which they are always situated."—Weller, 1907.

This species is very abundant in the Vincentown limesand at Vincentown, Mullica Hill and Timber Creek, New Jersey, but not so abundant at Noxontown Millpond, Delaware.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Genus MEMBRANIPORELLA Smitt

MEMBRANIPORELLA ABBOTTI (Gabb and Horn) Weller

Plate XLVI, Fig. 4

Escharipora abbottii Gabb and Horn, 1862, Jour. Acad. Nat. Sci., Phila. (2), vol. v, p. 149, pl. xx, fig. 33.

Repteschariporа marginata Gabb and Horn, 1862, *Ibidem*, p. 151, pl. ii, fig. 35.

Membraniporella abbotti Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 342, pl. xxiv, fig. 13, 14.

Description.—"Zoarium encrusting or growing in bifoliate plates. Zoœcia elongate-subelliptical or subhexagonal in outline, usually arranged in more or less regular longitudinal series and in quincunx, about 0.5 mm. in length, the length about twice the width. Zoœcial apertures subcircular or subquadrate with rounded angles, sometimes rounded in front and truncate posteriorly; they are situated anteriorly and occupy about one-third of the length of the zoœcium; back of the aperture the surface is covered by a thin, flat or slightly convex wall slightly depressed below the zoœcial margin, which is marked by about fourteen or fifteen lateral grooves radiately arranged posteriorly, leaving a narrow, smooth area along the median line, these grooves are either slit-like openings through the wall or they are pierced by lines of pores, it cannot be determined which from the specimens observed. Avicularia usually two to each zoœcium; subovate in outline and situated one on each side of the zoœcial aperture, from the lateral margins of which they are directed obliquely outward and backward. Ovicells present or absent, subglobular in form, situated just in front of the zoœcial apertures."—Weller, 1907.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Family ESCHARIDAE

Genus MUCRONELLA Hincks

MUCRONELLA ASPERA Ulrich

Plate XLVI, Figs. 8, 9

Mucronella aspera Ulrich, 1901, Maryland Geol. Survey, Eocene, p. 221, pl. lx, figs. 17, 18.

Description.—" Zoarium encrusting, consisting of one or more layers; surface under a low power of magnification presenting a decidedly rough aspect. Zoœcia varying from ovate-hexagonal to subrhomboidal, indistinct externally, arranged more or less irregularly, though the rows are more regular than may appear at first sight; about six in 2 mm. Apertures rounded or subquadrate, 0.13 mm. in diameter, rendered oblique by the elevation of the more or less strongly swollen posterior margin and the depression of the anterior part. The central portion of the raised lip forms a " mucro " of greater or less thickness and prominence, the same hiding a minute central tooth beneath it, and forming with the rest of the thickened portion of the lip a more or less obscure resemblance to the figure W. Behind the lip, the surface slopes rapidly and in the most nearly perfect example is granulose. In the depressed space in front of the aperture there are, normally, three small raised avicularia (? vibracula), while a few larger avicularia, differing further from the others in being divided into two unequal parts by a cross-bar, are scattered without order among the zoœcia. Oœcia are not often seen. When present they occupy the depressed space in front of the aperture, are cucullate, about as large as the zoœcial aperture, and usually bear a furrow running from the summit to the concave edge."—Ulrich, 1901.

The encrusting zoarium, mucronate aperture, and the small raised avicularia will serve for the recognition of this species.

This species is not uncommon in the Vincentown limesand of the Upper Cretaceous at Vincentown, New Jersey. Common at the same horizon in Delaware. The species also occurs rarely in the Lower Eocene (Aquia) at Upper Marlboro, Maryland.

Occurrence.—RANCOCAS FORMATION. South side of Appoquinimink Creek between mill-dam and Odessa, and at Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Family HIPPOTHOIDAE

Genus HIPPOTHOA Lamouroux

HIPPOTHOA TENUICHORDA (Ulrich and Bassler)

Plate XLVI, Fig. 16

Stomatopora tenuichorda Ulrich and Bassler, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 314, pl. xx, figs. 5, 6.

Corynotrypa tenuichorda Bassler, 1911, Proc. U. S. Nat. Mus., vol. xxxix, p. 513, fig. 11.

Description.—" Zoarium adnate, frequently branching, consisting of uniserially arranged zoœcia. Zoœcia elongate-pyriform, or club-shaped, 0.45 mm. to 0.75 mm. in length, about 0.02 mm. in width at the posterior extremity, increasing very gradually in size through about one-half their length, and then somewhat abruptly to about 0.15 mm. at the rounded anterior end. Zoœcial aperture nearly terminal, small, circular, with a slightly elevated, rim-like border, from 0.035 mm. to 0.05 mm. in diameter."—Ulrich and Bassler, 1907.

This neat little species was at first thought to belong to the *Cyclostomata,* although its relationship to *Hippothoa* was noted under the remarks in the original description. Further study has shown that in all probability the species is actually one of the genus *Hippothoa.*

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

VERMES

CLASS ANNELIDA

Order POLOCHAETA

Suborder TUBICOLA

Family SERPULIDAE

Genus SERPULA Linné

[Systema Naturæ, ed. x, 1758, p. 786]

Type.—*Serpula seminulum* Linné.

Solitary or gregarious tubicolous annelids; tubes free or adherent, usually more or less contorted or convoluted.

Etymology: *Serpula*, serpent.

The genus has been reported from strata as early as the Silurian. In the Purbeck beds of northwest Germany one member of the genus *Serpula* attains considerable importance as a rock-builder. Recent *Serpulæ* are world-wide in distribution.

The classification of the fossil annelids is of necessity in a lamentable state, since only the most superficial characters are available for determining the identity of species. In many cases it is impossible to tell whether the tube in question was secreted by a worm or a mollusc, although, as a rule, the latter can be isolated by the presence of internal septæ and of only two instead of three constituent layers of shell substance. However, it is highly probable that a large number of tubes have been referred to this group which are properly referable to the tube-secreting univalves.

A. Tubes free; subcircular in cross-section................*Serpula whitfieldi*
B. Tubes adherent; tubes triangular in cross-section......*Serpula trigonalis*

SERPULA WHITFIELDI Weller

Diploconcha (Serpula?) cretacea ? Whitfield, 1892, Mon. U. S. Geol. Survey, vol. xviii, p. 170, pl. xx, fig. 25. (Not *Diploconcha cretacea* Conrad.)
Serpula whitfieldi Weller, 1907, Geol. Survey of New Jersey, Pal., vol. iv, p. 308, pl. xix, fig. 2.

Description.—"Tubes irregularly arcuate, slightly flexuose, increasing in diameter very gradually; surface of shell lamellose where partially exfoliated, in cross-section appearing to be made up of concentric lamellæ. The dimensions of the largest tube observed are: Total length 70 mm., maximum diameter 6.5 mm."—Weller, 1907.

Type Locality.—Crosswicks Creek, New Jersey.

Occurrence.—MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Prince George's County.

Collections.—Maryland Geological Survey, Columbia University.

Outside Distribution.—*Monmouth Formation.* Navesink marl, New Jersey.

SERPULA TRIGONALIS n. sp.

Plate XLVII, Fig. 15

Description.—Tubes of two layers, recumbent, contorted, adherent in the type to the inner surface of a bivalve; tapering from a fine cord to a mere thread, cross-section slightly ovate, medial carina developed along

the entire length of the tube, increasing slightly in prominence with the growth of the shell; external sculpture absent, excepting for fine incremental corrugations; no trace of internal laminæ detected.

Dimensions.—Longitude when straightened 23 mm., maximum diameter 2.02 mm., minimum diameter 0.04 mm.

Occurrence.—RANCOCAS FORMATION. Noxontown Millpond, Delaware.

Collection.—Maryland Geological Survey.

Genus HAMULUS Morton

[Morton, Syn. Org. Rem. Cret. Group, 1834, p. 73]

Type.—*Hamulus onyx* Morton.

"Tubular, regular, involuted; volutions distinct; aperture circular." —Morton, 1834.

A solitary form characterized by a falcate or involuted and frequently alate tube, closed at the smaller end. The genus is apparently confined to the Cretaceous.

HAMULUS ONYX Morton.

Hamulus onyx Morton, **1834, Syn. Org. Rem. Cret. Group, p. 73, ? pl. ii, fig. 8; pl. xvi, fig. 5.**

Hamulus onyx **Gabb, 1859, Cat. Inv. Fossils, Cret. Form., U. S. p. 1.**

Hamulus squamosus **Gabb, 1859, *Ibidem*, U. S. p. 1.**

Hamulus squamosus **Gabb, 1860, Jour. Acad. Nat. Sci., Phila., 2d ser., vol. iv, p. 398, pl. lxviii, fig. 45.**

Description.—"With six elevated, angular, longitudinal ribs extending from base to apex. Length about an inch. The imperfect specimen figured on plate ii was obtained by Dr. Blanding at Lynch's Creek, South Carolina, in the green sand, and on a former occasion was supposed to be a *Dentalium*. Pl. xvi, fig. 5, however, represents the perfect shell from the older cretaceous deposits at Erie, Alabama. I have a small individual from New Jersey. It has never been found attached."—Morton, 1834.

Type Locality.—Erie, Alabama.

Hamulus squamosus was described by Gabb as "very closely allied to *H. onyx,* but differing in having a strongly marked raphe, which nearly doubles the width of the shell." Apparently Gabb's species was described from a young form, while Morton's *H. onyx* represents the normal adult.

Thus the posterior portion of the shell in fully developed individuals represents *H. squamosus* Gabb, the anterior portion *H. onyx* Morton.

The species is widely distributed in the Monmouth of Prince George's County, but it is exceedingly brittle and difficult to separate from the matrix.

Occurrence.—MATAWAN FORMATION. Ulmstead Point, Anne Arundel County. MONMOUTH FORMATION. Brightseat, Brooks estate near Seat Pleasant, Friendly, 1 mile west of Friendly, Prince George's County.

Collection.—Maryland Geological Survey.

INCERTAE SEDIS

Family SERPULIDAE (?)

Genus ORNATAPORTA n. gen.

Type.—*Ornataporta marylandica* Gardner n. sp.

Tube small, tapering gradually toward the aperture; operculum reticulately sculptured.

ORNATAPORTA MARYLANDICA n. sp.

Plate XLVII, Figs. 16-19

Description.—Tubes rather small, usually more or less arcuate, slightly tapering, smaller end of tube in two individuals obliquely truncated at an angle of about 30°; truncated surface in cast subcircular to broadly elliptical in outline, elaborately sculptured both radially and concentrically; radials fine, well rounded liræ, diverging in all directions from a strongly eccentric nucleus, possibly a little coarser on the shorter side, number more than doubled near the margin by intercalation and bifurcating; concentric sculpture in part incremental in character, two to five prominent growth stages usually visible; very fine and crowded threadlets also developed, not overriding the radials but closely dissecting the interradials.

Dimensions.—Length, 18.6 mm.; diameter of larger end, 6 mm.; diameter of smaller (operculum-bearing) end, 4.5 mm.

The nature of these extraordinary impressions is very obscure. When the first was found it was thought that the association of the tube with the sculpture might be fortuitous, but the discovery of a second similarly

Etymology: *Ornata*, elaborate; *porta*, a door.

sculptured and bearing the same relation to the enclosing tube made the theory of chance association untenable. Nothing like these forms has been observed in any branch of the animal kingdom, but they are less unlike the worms than any other phylum. There is, too, a wider range of variation in the Vermes than in any other of the major divisions. There are groups in which a calcareous operculum is secreted and groups in which the tube is gradually constricted toward the aperture and, although the combination of these two rather unusual characters is not known, yet it is not without the range of possibility. The sculpture, however, is much more regular and elaborate than any observed on the opercula of recent worms.

Professor Grabau, of Columbia University, to whom squeezes of the ornamented ends were shown, suggested that they might be the impressions of a test of a degenerate gastropod, possibly allied to the Acmæas, a hypothetical genus, which, when it lost the power to coil through lack of vitality, continued to grow in a plane at a high angle to that of the shell. So little is known of degenerate gastropods that one cannot define their limits of variation, and there is a possibility that this may be a bizarre type which arose, together with many other degenerate mollusca near the close of a great era. The writer is also under obligations to Mr. J. E. Benedict and Mr. Austin H. Clark for their suggestive interest in these organisms.

Occurrence.—Monmouth Formation. Brooks estate near Seat Pleasant, Prince George's County.

Collection.—Maryland Geological Survey.

ECHINODERMATA

Class ECHINOIDEA

Order CIDAROIDA

Family CIDARIDAE

Genus CIDARIS Leske

Cidaris sp.

Description.—Several fragmentary spines belonging to this genus were found amongst other materials from Appoquinimink Creek, Delaware. Two of the specimens show the basal portions of the spine with the collar

and condyle, but all the specimens lack the outer points. All of the fragments are nearly straight with slight taperings and are covered with rows of straight granules closely joined so as to impart a fluted appearance to the spines. The larger spines show twelve or more such lines.

Dimensions.—Length of longest specimen 14 mm., diameter of spine 2.5 mm.

Occurrence.—RANCOCAS FORMATION. South side of Appoquinimink Creek between Odessa and mill-dam, Delaware.

Collection.—Maryland Geological Survey.

Family CASSIDULIDAE

Genus CASSIDULUS Lamarck

CASSIDULUS sp.

Description.—Test small, elevated, slightly truncated at the posterior end; upper surface very convex, sides nearly straight, ends rounded; under surface nearly flat but much broken. Ambulacral areas narrow. Apical system small, slightly anterior of the center. Peristome lacking. Periproct small and a long shallow sulcus.

Dimensions.—Length 12 mm., width, 9.5 mm., height 7 mm.

The single specimen of this form that has been found has the lower surface badly damaged, but there is little doubt that it is a representative of the genus *Cassidulus* so widely found in Upper Cretaceous strata farther south. It is, however, quite distinct from any other known species, but because of its fragmentary character it seems unwise to give it a name at the present time.

Occurrence.—MONMOUTH FORMATION. Bluff northeast of mouth of Turner's Creek, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

Family ECHINOCORYTHIDAE

Genus CARDIASTER Forbes

CARDIASTER MARYLANDICA n. sp.

Plate XLVII, Figs. 6-10

Description.—Test small, cordate, with pronounced anterior grooves; upper surface slightly convex, lower surface flat. Ambulacra wide. Apical

system moderately elongated. Peristome very near anterior margin. Periproct oval and situated rather high on truncated posterior margin.

Dimensions.—Length 18 mm., width 18 mm., height 11.5 mm.

Several well preserved casts of this species have been collected. They show some points of similarity to *Cardiaster smocki* from the Matawan of New Jersey, but the Maryland form is more sharply contracted posteriorly and has a more pronounced anterior surface.

Occurrence.—MONMOUTH FORMATION. Brightseat, Prince George's County.

Collection.—Maryland Geological Survey..

Family SPATANGIDAE

Genus HEMIASTER Desor

HEMIASTER DELAWARENSIS n. sp.

Plate XLVII, Figs. 11-14

Description.—Test small, nearly circular, slightly cordiform, truncated posteriorly; upper surface slightly convex, elevated posteriorly; lower surface nearly flat; sides inflated; apex nearly central, slightly posterior of the center; ambulacra slightly depressed, posterior pair short, anterior surface broad. Peristome slightly depressed. Periproct small, high above posterior margin. Peripetalous fasciole narrow, distinct.

Dimensions.—Length 22 mm.; width 22 mm.; height 17 mm.

A single well preserved specimen of this form was collected by Dr. M. W. Twitchell. It presents some points of similarity to *Hemiaster bexeri* from the Washita group of Texas, but the height of the present specimen is somewhat greater and the ambulacral furrows are on the whole less depressed. It is also somewhat similar to *Hemiaster stella* from the Rancocas formation of New Jersey, but the latter species has not the broad depressed anterior surface of the present species.

Occurrence.—MATAWAN FORMATION. Marl pit south side of Delaware and Chesapeake Canal 1 mile east of St. George's Delaware.

Collection.—Johns Hopkins University.

HEMIASTER sp.

Description.—A few imperfect and fragmentary specimens of a *Hemiaster* have been found in the indurated layers of the Matawan formation on the Chesapeake and Delaware Canal. Two specimens show quite clearly the anterior ambulacral furrow with part of the adjacent anterior path. These forms may belong to the species *Hemiaster welleri* from the Matawan of New Jersey.

Occurrence.—MATAWAN FORMATION. One and one-half miles east of the Maryland-Delaware Line, Chesapeake and Delaware Canal, Delaware.

Collection.—Maryland Geological Survey.

COELENTERATA

CLASS ANTHOZOA

Subclass HEXACORALLA

Order MADREPORARIA

Suborder APOROSA

Family TURBINOLIDAE

Genus TROCHOCYATHUS Milne Edwards and Haime

TROCHOCYATHUS (?) VAUGHANI sp. nov.

Plate XLVIII, Figs. 5, 6

Description.—Corallum cuneiform, with no recognizable scar of attachment; viewed from the side it is subtriangular in outline and a little elongated in the direction of the height; cross-section lenticular with dull acute angles at the ends.

Theca well developed. Corresponding to the septa are strong, subacute, tuberculated ribs with deep intercostal depressions; new ribs are intercalated as new septa are formed; on the sides bordering the acute edges are tuberculated bands broadest below, narrowing to the serrated edge above.

Septa about thirty-six, of which about twenty-four extend inward to the columella. The septa are in three or four cycles, but the different

cycles cannot be clearly differentiated. The members of the last cycle are very thin and frail. The inner edges of the principal septa are fused to the columella and to adjoining septa by trabecular-like processes. There is a suggestion of paliform lobes, though the upper edges of the septa are too imperfect to permit positive determination of this feature. Sides of septa set with small tubercles and spine-like processes, the arrangement of which cannot clearly be seen in the specimen.

There is doubt as to the mode of origin of the columella, but it appears to be spongy and trabecular.

Dimensions.—Longest transverse axis at top, about 5 mm.; shortest transverse axis, 2.5 mm.; height, 4.5 mm.

Named in honor of Dr. T. Wayland Vaughan.

Occurrence.—MONMOUTH FORMATION (*Exogyra costata* zone). Bed of small branch about seven-eighths of a mile southwest of Brightseat and three-eighths of a mile south of the Sheriff road, Prince George's County.

Collection.—Maryland Geological Survey, on deposit in the U. S. National Museum.

Suborder FUNGIDA

Family MICRABACIIDAE

Genus MICRABACIA Milne Edwards and Haime

MICRABACIA ROTATILIS sp. nov.

Plate XLIX, Figs. 1-4

Description.—Corallum subdiscoidal; moderately high with flat to rather strongly concave base; sides steep below, rounding evenly into the subflattish top; axial depression 1.5 mm. to 2 mm. deep.

The costæ on the base are thin, sharply defined, and alternate with the septa; they start with six at the center, and by successive bifurcations increase to ninety-six on the periphery; they are nearly smooth and increase slightly in thickness from the center to the periphery. The costæ are in six groups corresponding to the groups of septa. Each group starts with one costa (first cycle), which bifurcates near the center to form two costæ (second cycle); these bifurcate 0.5 mm. from the center to form

four costæ (third cycle); the four bifurcate about 1 mm. from the center and produce eight costæ (fourth cycle); and the eight bifurcate 1.5 mm. to 2 mm. from the center, producing sixteen costæ (fifth cycle); in the last cycle the bifurcations producing the two outer and the two middle pairs of the group take place nearer the center than do those of the other four pairs; in the largest specimens the pairs of costæ in the last cycle are 2.5 mm. to 3 mm. long. The ends of the costæ are prow-like, but scarcely project beyond the edges of the septa. The intercostal loculi are narrow and are crossed by small synapticulæ separated by radially elongated perforations; in the type the perforations in the intercostal loculi extending to the center number eighteen; the intercostal synapticulæ and perforations are roughly arranged in concentric rows.

The septa are thin and form five complete cycles arranged in six groups, one group in each of the interspaces between the primary septa. Total number of septa ninety-six. The secondaries extend to the columella; the tertiaries fuse against the secondaries near the columella; the two outer quaternaries of the group fuse against the tertiaries nearer the center than do the two inner ones; the two outer quinaries of each of the subgroups formed about the tertiaries fuse against the quaternaries nearer the center than do the two inner ones. The primary septa are a little higher than the members of the higher cycles, and the septa of the succeeding cycles appear to be each a little lower than those of the preceding cycles. The edges of the septa are finely and distinctly denticulate, the number of denticulations being eight or nine to 1 mm.; the inner edges of the primaries and secondaries are bifid, each presenting a trough-like depression with serrated margins descending to the top of the columella; sides of septa with striæ, tubercles, and rows of synapticulæ radiating fan-like from near the base of the columella. Each septum is joined to the wall (base) by synapticulæ which connect with the intercostal synapticulæ. These are separated by perforations which connect with the intercostal perforations.

Columella elliptical in cross-section, spongy, trabecular, some of the trabeculæ terminating above in more or less scattered, irregularly dis-

tributed, small papillæ; length of cross-section about one-sixth the diameter; width about one-twentieth the diameter.

The species differs from other species of *Micrabacia* from the Coastal Plain in the greater sharpness and smoothness of the basal costæ, the greater irregularity in the distance of the bifurcations of the several cycles from the center, the greater length of the costæ of the last cycle, the greater number of intercostal perforations, and the greater size attained by the adults. It is distinguishable from *M. rotatilis* var. *georgiana*[1] by its smoother and slightly thicker costæ. *M. americana* Meek and Hayden, and its variety, *multicostata*,[1] have more strongly denticulate bases. In *M. coronula* (Goldfuss) of the European Cretaceous the denticulations of the septal edges are markedly coarser than those of any of the American species.

Dimensions (of the type).—Diameter 9 mm., height about 4 mm.

Occurrence.—MONMOUTH FORMATION (*Exogyra costata* zone). Bed of small branch about seven-eighths of a mile southwest of Brightseat and three-eighths of a mile south of the Sheriff road; near McNeys Corners, about a mile west of Friendly; questionably near Seat Pleasant, Prince George's County.

Collection.—Maryland Geological Survey, on deposit in the U. S. National Museum.

MICRABACIA MARYLANDICA sp. nov.

Plate XLVIII, Figs. 1-4

Description.—Corallum low to moderately high, subdiscoidal; base flat or slightly convex; top evenly convex with a small axial depression about 1.25 mm. deep in the type.

The underside of the base or wall is ornamented with a system of radiating bifurcating costæ which alternate with the septa; the system starts with six costæ which, by successive bifurcations, form cycles of 12, 24, 48, and 96 costæ. Each of the original six costæ (first cycle) is the focus of a group; the original of each group splits near the center into two

[1] Described by the writer in Prof. Paper U. S. Geol. Survey, No. 98J, now in press.

(second cycle), and these split 0.5 mm. from the center into four (third cycle); about 1.5 mm. from the center each of the four costæ divides to form eight (fourth cycle), and about 2.5 mm. from the center in the type each of the eight divides, producing sixteen costæ (fifth cycle) on the outer rim. The bifurcations of each cycle are at nearly equal distances from the center. The costæ up to the cycle of forty-eight are relatively thick and coarsely nodular; those of the last cycle are thin, finely denticulate, and form a band about $\frac{3}{4}$ mm. wide, bordering the outer margin; they appear not to project beyond the edges of the septa. The intercostal loculi are very narrow and are occupied by twelve or thirteen synapticulæ separated by perforations, most of which are slightly elongated radially; the synapticulæ and perforations are arranged in concentric rows.

The septa are very thin and are arranged in six groups, one group in each of the interspaces between the primary septa. Total number of septa ninety-six. The secondaries extend to the columella; the tertiaries fuse against the secondaries near the columella; the two outer quaternaries of the group fuse against the tertiaries nearer the center than do the two inner ones; in each of the two subgroups formed about the tertiaries the two outer quinaries fuse against the quaternaries nearer the center than do the two inner ones. The primary septa are slightly higher than the members of the higher cycles which appear to be of about equal height. On the sides of the corallum the septa distinctly alternate in prominence. Margins of the septa finely denticulate, the number of denticulations being about ten to 1 mm. Sides of septa with striæ and rows of synapticulæ and tubercles radiating from near the base of the columella.

Columella elliptical, spongy, trabecular, some of the trabeculæ terminating in more or less scattered, irregularly distributed, small papillæ; length of cross-section between one-fifth and one-sixth the diameter; width about one-tenth the diameter.

This species differs from the other species of *Micrabacia* as follows:[1] *M. hilgardi* differs in size, form, and ornamentation of the base. The corallum is smaller, the sides straighter and more inclined, and the septal

[1] The species mentioned in this paragraph, with the exception of *M. americana* and *M. coronula*, are described by the writer in Prof. Paper U. S. Geol. Survey, No. 98J, now in press.

edges on the sides of the corallum do not alternate in prominence. The bifurcations of the separate cycles of costæ are at more irregular distances from the center and the costæ are thinner and more finely denticulate. In *M. cribraria* the costæ and perforations of the base are largely obscured by irregular calcification and the costæ project more prominently on the periphery. In *M. mississippiensis* the basal costæ are narrower, smoother, and flatter, the bifurcations of each cycle are more irregularly spaced with reference to the center, and the profile of the side of the corallum is not so steep and is slightly truncated. In *M. rotatilis* the basal costæ are thinner, sharper, and much smoother. In *M. americana* the costæ are narrower and sharper, and the bifurcations producing the last cycle take place much nearer the center and at less regular distances from the center. In *M. coronula* the corallum is higher and the septal denticulations coarser.

Dimensions (of the type).—Diameter 7 mm., height 3 mm.

Occurrence.—Monmouth Formation (*Exogyra costata* zone). Bed of small branch seven-eighths of a mile southwest of Brightseat and three-eighths of a mile south of the Sheriff road; about a mile west of Friendly, Prince George's County.

Collection.—Maryland Geological Survey, on deposit in the U. S. National Museum.

THALLOPHYTA

Class FUNGI

Order PYRENOMYCETES

Genus SPHAERITES Unger

[Gen. et Sp., 1850, p. 37]

Sphærites raritanensis Berry

Plate LXXXI, Fig. 3

Sphærites raritanensis Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 62.

Description.—Viewed megascopically these remains appear as oval or circular umbilicate dots from .25 mm. to .5 mm. in diameter, with depressed margin and enlarged central portion, the latter occupying two-thirds of the total diameter.

This species was based upon a leaf-spot fungus found in abundance on the under side of leaf fragments (sp. indet.) in the matted layers of fossil leaves from the upper Raritan at the Hylton pits in New Jersey. Identical remains are not uncommon in the Magothy formation of Maryland. Their characteristic appearance is indicated on the photographic reproduction of a leaf of *Eucalyptus geinitzi* (Heer) Heer.

These remains are conclusively congeneric with the forms usually referred to this genus and very similar to *Sphærites problematicus* (Knowlton) Knowlton from the Dakota group of Kansas. The latter is, however, more irregular in outline, larger in size, and infests *Sterculia* which is not the host of the present species. While remains of this sort are of little botanical interest to some, they nevertheless have a considerable biological significance in the evidence which they afford of the existence during the mid-Cretaceous of fungi of this order.

Occurrence.—MAGOTHY FORMATION. Sullivan's Cove, Anne Arundel County.

Collection.—Maryland Geological Survey.

CLASS ALGAE

Genus ALGITES Seward

[Wealden Flora, Part I, 1894, p. 4]

A generic term proposed by Seward for those fossil remains which are in all probability those of Algæ, but which from their nature cannot be decisively compared with any one genus of known botanical affinity.

Fossil algæ are common fossils at some geological horizons, but they are usually indecisive in their characters, especially when preserved as impressions, so that comparisons with modern genera altogether lack certainty. As has been pointed out by Seward (*loc. cit.*) for the type of this genus, *Algites valdensis* of the English Wealden, these forms suggest various modern genera such as *Chondrus, Zonaria, Dictyota,* etc.

ALGITES AMERICANA Berry

Plate L, Fig. 1

Algites americana **Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 401.**

Description.—Thallus as preserved, in the form of dichtomously divided branches ranging in width from 2 mm. to 5 mm., thin and undulating

as preserved, but rather coriaceous in life, with slightly wavy margins. These branches are not preserved for lengths of more than a few centimeters, during which interval they are observed to divide but once or not at all. They have the appearance in some specimens of radiating from a common center, but as their proximal parts are invariably missing this supposition cannot be verified.

The Maryland remains are rare and in the form of impressions, along which recent rootlets have often permeated the argillaceous matrix, sometimes giving the specimens the appearance of having midribs. The North Carolina remains, which are abundant in the Black Creek beds at certain localities along the Black River, often show considerable carbonaceous residuum indicating that in life the thallus was of considerable consistency.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—U. S. National Museum.

PTERIDOPHYTA

Order LYCOPODIALES

Family LYCOPODIACEAE

Genus LYCOPODIUM Linné

[Sp. Pl., 1753, p. 1100]

LYCOPODIUM CRETACEUM Berry

Plate L, Figs. 10, 11

Lycopodium cretaceum Berry, 1910, Amer. Jour. Sci., 4th ser., vol. xxx, pp. 275, 276, figs. 1-6.

Lycopodium cretaceum Berry, 1914, Prof. Paper, U. S. Geol. Survey, No. 84, pl. ii, figs. 1-6.

Description.—Spikes loosely imbricated, of modified foliage leaves or bracts. The largest spike, which is nearly complete, is 5 cm. in length and 5 mm. in diameter, and is probably somewhat flattened, the bulk of the specimens indicating somewhat smaller dimensions. Axis stout. Bracts several ranked, peduncled, with a cordate or retuse base and an abruptly

narrowed acute recurved apex, with an entire margin, each bract subtending a large spheroidal sporangium which may possibly be reniform, though in the impressions preserved in the clays it appears to be globular.

This unique species is represented by rather scanty material in the Maryland area which, however, shows the outlines of sporangia in the axis of the bracts. It was described from very abundant remains preserved in the clays of the Middendorf member of the Black Creek formation in South Carolina. It is also sparingly represented in the lower Tuscaloosa beds of western Alabama and is thus shown to have had a considerable geographic range. Preparations have failed to reveal any traces of spores in the sporangia.

Fossil remains of foliage resembling that of the modern club mosses have been frequently described, either as *Lycopodium* or *Lycopodites* Brongniart, but the majority of such determinations lack certainty in that they show neither anatomical nor fruiting characters, so that the present species is of great interest as the only post-Paleozoic fossil known to the writer which is referable with absolute certainty to the genus *Lycopodium*. No remains of foliage have been discovered in these clays which can be correlated with these fruiting spikes.

Occurrence.—MAGOTHY FORMATION. Little Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Order FILICALES

Family GLEICHENIACEAE

Genus GLEICHENIA Smith

[Mem. Ac. Turin, vol. v, 1791, p. 418]

GLEICHENIA ZIPPEI (Corda) Heer

Pecopteris zippei Corda, 1846, in Reuss, Versteinerungen, p. 95, pl. xlix, fig. 1.
Pecopteria zippei Unger, 1867, Kreidepflanzen aus Oestereich, p. 8, pl. ii, fig. 1.
Gleichenia zippei Heer, 1868, Fl. Foss. Arct., Bd. i, p. 79, pl. xliii, fig. 4.

Gleichenia zippei Heer, 1874, *Ibidem*, Bd. iii, Ab. ii, pp. 44, 90, 97, pl. iv; pl. v; pl. vi, figs. 1-3; pl. vii, fig. 2; pl. xxv, figs. 1-3; pl. xxvi, figs. 10-13.

Gleichenia zippei Heer, 1877, *Ibidem*, Bd. iv, p. 49, pl. xxxii, figs. 6, 7.

Gleichenia zippei Heer, 1882, *Ibidem*, Bd. vi, Ab. ii, p. 36, pl. iii, fig. 2.

Gleichenia zippei Velenovsky, 1888, Farne böhm, Kreidef., p. 6, pl. iii, figs. 3-7.

Gleichenia zippei Newberry, 1896, Mon. U. S. Geol. Survey, pt. ii, p. 664, pl. clxii, fig. 9.

Gleichenia zippei Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 67, pl. iv, fig. 6.

Gleichenia zippei Berry, 1906, *Ibidem*, vol. xxxiii, p. 164.

Gleichenia zippei Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 64.

Description.—" Gl. foliis bipinnatis, pinnis valde approximatis, elongatis, linearibus, parallelis, pinnatisectis, pinnulis obliquis, lanceolatis, acutiusculis, integerrimis, basi vix unitis; nervis pinnatis, nerv. secund. utrinque 3-5, inferioribus furcatis,"—Heer, 1868.

The determinations of this species in the Atlantic Coastal Plain are all based upon very fragmentary specimens, although some of them have traces of the sori preserved. In sharp contrast is the beautiful *Gleichenia* material obtained by Professor Heer from Greenland. As far as the Coastal Plain material goes it corresponds exactly with the more typical material from other regions, and until specimens are collected showing adequate grounds for separation, it is justifiable to assume that this species was present along the Middle Atlantic Coast in Raritan and Magothy time. The genus *Gleichenia* was a prominent one during the Cretaceous with many characteristic species, some with a wide range. The present species which ranges through the Greenland Cretaceous series from the Kome beds (Lower Cretaceous) to those of Patoot (Upper Cretaceous) occurs also in the Lower Cretaceous of Spitzbergen and the Black Hills; the Cenomanian of Bohemia; the Senonian of Bohemia, Saxony, and Bulgaria; the Magothy formation of New Jersey and Delaware; and it has recently been collected in the Upper Cretaceous of the Western Interior. It is not contained in any recent collections from the Raritan.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

GLEICHENIA DELAWARENSIS Berry

Plate L, Figs. 5, 6

Gleichenia delawarensis Berry, 1907, Johns Hopkins Univ. Circ., n. s., No. 7, p. 82, figs. 3, 3a.
Gleichenia delawarensis Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 20.

Description.—Frond unknown; pinnules subopposite, obovate, 2 mm. to 3 mm. long by 1 mm. to 1.5 mm. wide, attached by their greatly narrowed bases to the rather slender rachis; venation of the *Gleichenia* type rather indistinct in most of the pinnules.

This fragment of a pinna is 27 mm. It is doubtfully referable to *Gleichenia*, to which such a large number of fern impressions of Cretaceous age have been assigned. The most similar among previously described species is, perhaps, *Gleichenia nordenskioldi* Heer known from the Kome beds of Greenland, the Dakota of Kansas, and the Knoxville of California, which differs markedly in the shape of the base of the pinnules.

While a knowledge of the structure or fructification is essential for the conclusive proof of the botanical affinity of fern fragments such as this, it is important for geologists that such characteristic types shall be figured and described in order that they may serve as horizon-makers.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

GLEICHENIA SAUNDERSII Berry

Plate L. Figs. 7-9

Gleichenia saundersii Berry, 1903, Amer. Nat., vol. xxxvii, p. 679, figs. 1-3.
Gleichenia saundersii Berry, 1906, Ann. Rept. State Geol. of New Jersey for 1905, pp. 139, 141.
Gleichenia saundersii Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 163.

Description.—Pinnules broadly falcate-ovate, entire, bluntly pointed; attached by a wide base, about as wide as the pinnule is long; length 4.5 mm. ultimately becoming much smaller, each with a stout mid vein which sends off alternately on each side rather thick veins to the margin,

those running distad are all simple except the basal one which is sometimes forked, those running proximad are usually once forked; texture thick and coriaceous.

This species is close to *G. gracilis* Heer, but the venation differs in the number of veins and their habit of forking. It was described from Cliffwood Bluff on Raritan Bay, and has also been recorded from Kinkora on the Delaware River. It is known only from the Magothy formation.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Family OSMUNDACEAE

Genus OSMUNDA Linné

[Sp. Pl., 1753, p. 1063]

OSMUNDA DELAWARENSIS Berry

Plate L, Figs. 2-4

Osmunda delawarensis **Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 164, pl. viii, figs. 2-4.**

Osmunda delawarensis **Berry, 1907, Md. Geol. Survey, vol. vi, pl. xx, fig. 17.**

Description.—Fronds pinnate. Pinnæ simple, alternate, elongate, linear-lanceolate, inequilateral at the base. Borders undulate, very slightly crenulate; frond substance thick. Pinnæ 7.5 cm. long, 5-6 mm. wide near the base, tapering to a long narrow point, closely resembling the sterile pinnæ of *Osmunda presliana* J. Smith of the east and south Asiatic region, except that the latter has a narrowed base, while the present species has a large base, more like that in *Osmunda regalis* Linné.

Whether the larger specimen figured is a pinnule of a bipinnate form like the modern cosmopolitan "Royal Fern" it is impossible to judge from the material thus far collected.

The *Osmundaceæ* are rather common and widespread in the older Mesozoic, represented by structural material as well as frond genera such as *Todites,* etc. Various fossil species have been referred to *Osmunda* or *Osmundites,* including two or three forms from the Lower Cretaceous described by Fontaine from Virginia and showing supposed fructification.

The genus *Osmunda* contains in the existing flora some six or seven species of swamp-loving ferns, most of them confined to the northern hemisphere, where they are wide-ranging. Three of these forms occur in North America.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

Family POLYPODIACEAE

Genus ONOCLEA Linné

[Sp. Pl., 1753, p. 1062]

ONOCLEA INQUIRENDA (Hollick) Hollick

Plate LI, Figs. 1, 2

Osmunda obergiana Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 98 (pars), pl. xxvi, fig. 9d (non figs. 9-9b or pl. xxxii, fig. 7a).

Caulinites inquirendus Hollick, 1904, Bull. N. Y. Bot. Garden, vol. iii, p. 406, pl. lxx, fig. 3.

Onoclea inquirenda Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, 1906, pl. i, figs. 1-7.

Onoclea inquirenda Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 401, pl. xviii, figs. 1, 1a.

Onoclea inquirenda Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 14, pl. ii, figs. 7, 8.

Description.—Fragments of fertile fronds, not showing any lamina, which appears to be reduced to short pinnate branches bearing one or more spheroidal bodies interpreted as sori. These are uniformly 1.5 mm. or slightly less in diameter.

This species was originally described by Hollick (*loc. cit.*) and referred to the genus *Caulinites,* but subsequently was removed to the ferns because of its resemblance to the modern genus *Onoclea,* a resemblance that is close and not at all fanciful. Earlier figured forms of the same character were associated by Heer with his species *Osmunda obergiana* because they were found in the same beds with the fronds of this species, although they were not found in organic union with the fronds. These fruits are much more like those of the modern forms of *Onoclea* than they are like those of *Osmunda,* and they are identical with those which are the type of the present species to which the writer has referred them.

The Long Island and Marthas Vineyard forms have these sori in a single row on each side of an axis, and some of the South Carolina specimens seem to have a similar arrangement, while others have them definitely in threes, one terminal and two lateral. This latter arrangement also prevails exclusively in the Greenland specimen and in similar material from the Magothy formation of Maryland. This variation is of minor importance and is mentioned simply because it is believed that the grouping in threes is the normal arrangement, which has been obscured during fossilization in the instances where it is not clear.

As here understood this species ranges from the Atane beds of Greenland southward in the Magothy formation of Marthas Vineyard, Long Island and Maryland, to the Middendorf beds in South Carolina.

Occurrence.—MAGOTHY FORMATION. Round Bay, Maryland.

Collection.—U. S. National Museum.

Genus CLADOPHLEBIS Brongniart
[Tableau, 1849, p. 25]

This genus, which is essentially a form-genus, is usually restricted to certain fern-remains of Mesozoic age, a number of which are certainly to be referred to the family Polypodiaceæ. *Cladophlebis* has been fully discussed by the writer[1] in a recent volume of this series and need not be recharacterized in the present connection. It is a waning and unimportant type in Upper Cretaceous floras everywhere, a fact due in all probability to generic evolution and consequent modernization of the Upper Cretaceous Polypodiaceæ.

CLADOPHLEBIS SOCIALIS (Heer) Berry

Pecopteris socialis Heer, 1882, Fl. Fossils Arct., Bd. vi, Ab. ii, p. 34, pl. vii, fig. 4; pl. viii, fig. 15; pl. xxxiii, fig. 9 (non Fontaine, 1890).
Cladophlebis socialis Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 409.

Description.—" P. foliis bipinnatis, pinnis oppositis, elongatis, lanceolato-linearibus, inferioribus pinnatifidis, lobis, subtriangularibus, inte-

[1] Berry, Md. Geol. Survey, Lower Cret., 1911, pp. 239-259.

gerrimis, apice acutis, ultimis simplicibus, lanceolatis, magnis."—Heer, 1882.

The present species was described by Professor Heer from the Atane beds of western Greenland. Subsequently Fontaine identified as this species a very different form from the Patapsco formation of Virginia, a form that the writer has referred to *Cladophlebis browniana* (Dunker) Seward.[1]

Somewhat fragmentary remains that appear to be identical with Heer's type occur in the Raritan formation.

Occurrence.—RARITAN FORMATION. Shannon Hill, Cecil County.

Collection.—Maryland Geological Survey.

Genus ASPLENIUM Linné

[Sp. Pl., 1753, p. 1078]

ASPLENIUM CECILENSIS Berry

Plate LI, Figs. 3, 4

Asplenium cecilensis **Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. p. 403, pl. xviii, figs. 4, 5.**

Description.—Frond unknown. Pinnules linear-lanceolate, falcate, subopposite, united to the stout rachis by their entire bases, with entire margins and acute tips. The sterile pinnules are somewhat smaller than the fertile, being about 12 mm. or 13 mm. in length by 3 mm. in maximum width, which is at their base. They show a stout midrib which gives off about twenty-five branches on each side alternately above and below, and is lost in the apical region by this repeated branching. These branches subtend a considerable angle and are recurved. They fork once near their base and run directly to the margin. The fertile pinnules are somewhat larger than the sterile, being about the same length and slightly wider. They show stout midribs and the poorly preserved remains of numerous linear-lanceolate sori extending nearly from the midrib to the margin and obscuring the lateral veins, there being apparently a sorus to each forked lateral.

[1] Berry, Md. Geol. Survey, Lower Cretaceous, p. 243, 1911.

This species greatly resembles various forms from the Upper Cretaceous of Greenland, which Professor Heer referred to the genus *Pteris*, the resemblance to *Pteris albertsii* Heer being particularly marked. The latter is usually referred to the genus *Cladophlebis*, and this genus contains a number of forms that are comparable with *Asplenium cecilensis*. The fertile pinnules of the latter, imperfect as is their preservation, are clearly unlike those known in *Cladophlebis* and are clearly of a type allying this form with the *Asplenieæ*.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

ASPLENIUM DICKSONIANUM Heer

Asplenium dicksonianum **Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 31, pl. i, figs. 1-5.**

Asplenium dicksonianum **Heer, 1882, *Ibidem*, Bd. vi, Ab. ii, pp. 3, 33, pl. ii, fig. 2; pl. xxxii, figs. 1-8.**

Asplenium dicksonianum **Dawson, 1883, Trans. Roy. Soc. Can., vol. i, sec. iv, p. 11.**

Asplenium dicksonianum **Dawson, 1885, *Ibidem*, vol. iii, sec. iv, p. 5, pl. iii, fig. 1.**

Asplenium dicksonianum **Dawson, 1886, Ann. Rept. Can. Geol. Survey, n. s., vol. i, p. 76.**

Asplenium dicksonianum **Dawson, 1892, Trans. Roy. Soc. Can., vol. x, sec. iv, p. 91.**

Asplenium dicksonianum **Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 24, pl. i, fig. 1.**

Asplenium dicksonianum **Ward, 1894, Jour. Geol., vol. ii, pp. 259, 261.**

Asplenium dicksonianum **Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 39, pl. 1, figs. 6, 7; pl. ii, figs. 1-8; pl. iii, fig. 3.**

Asplenium dicksonianum **Ward, 1899, 19th Ann. Rept. U. S. Geol. Survey, pt. ii, p. 704, pl. clxx, fig. 1.**

Asplenium dicksonianum **Fontaine, 1899, *Ibidem*, p. 664, pl. clxii, figs. 6-8 (non Fontaine, 1888).**

Asplenium dicksonianum **Kurtz, 1902, Cont. Palæophyt. Argentina iii, Revista Museo La Plata, vol. x, p. 49 (1899).**

Asplenium dicksonianum **Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 409.**

Asplenium dicksonianum **Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 68, pl. v, figs. 3, 4.**

Description.—" A. foliis triplicato-pinnatis, stipite firmo, rigido; pinnis primariis secundariisque ovato-lanceolatis, pinnulis anguste lanceolatis,

inferioribus acute serratis, superioribus integerrimis, acutis."—Heer, 1874.

This species was described originally by Heer from the Kome beds (Lower Cretaceous) of Greenland and was subsequently identified by the same author from the much later Atane beds (Upper Cretaceous). Dawson reported it from a number of localities in the Kootenai of British Columbia, and Fontaine and Ward described it from the Lower Cretaceous of the Black Hills. It is also reported by both Lesquereux and Ward from the Dakota group and by Kurtz from Argentina. It seems very doubtful if these can all refer to the same plant, and the geologic range alone suggests that the earlier and later forms may be distinct. The Lower Cretaceous forms certainly suggest a relationship with those widespread types of sterile fronds variously identified as *Thyrsopteris* or *Onychiopsis,* and may be compared with *Onychiopsis goepperti* (Schenk) Berry, while those from the Upper Cretaceous suggest *Anemia* rather than *Asplenium* and are much like an undescribed *Anemia* from the Lower Eocene (Wilcox) of the Mississippi embayment areas as well as the widespread Eocene species *Anemia haydenii* (Lesquereux) and *Anemia subcretacea* (Saporta) Gardner and Ettingshausen. However, in the absence of representative material from the different horizons, it seems unwise to attempt any segregation at the present time and the synonymy is cited in full for the use of some future student who may have access to enough material to enable an accurate revision and segregation of this so-called species. Attention should also be called to its resemblance to the form occurring in the Upper Cretaceous of Greenland, the Raritan fromation of New Jersey and the Tuscaloosa formation of Alabama, which goes by the name of *Dicksonia greenlandica* Heer, although the ground for considering it a *Dicksonia* is as entirely inconclusive as is the reference of the present species to the genus *Asplenium.*

In addition to the localities enumerated above, the present species is abundant in the New Jersey and Maryland Raritan, and material that is absolutely identical with the New Jersey material and that from the Dakota sandstone occurs in the lower Tuscaloosa formation of Alabama.

Occurrence.—RARITAN FORMATION. Shannon Hill, Cecil County, Maryland; East Washington Heights, District of Columbia.

Collection.—Maryland Geological Survey.

CYCADOPHYTA

CLASS CYCADOPHYTAE

Order WILLIAMSONIALES

Family WILLIAMSONIACEAE

Genus WILLIAMSONIA Carruthers

[Trans. Linn. Soc. Lond., vol. xxvi, 1868, p. 680]

WILLIAMSONIA MARYLANDICA n. sp.

Plate LI, Figs. 5, 6

Description.—Staminate bract or sporophyll of a Williamsonia-like form of small size. Sporophyll flat and relatively thin, smooth, about 14 mm. in length and 4 mm. in maximum width, spatulate-lanceolate in outline, *i. e.,* lanceolate-acuminate, widest distad and constricted and somewhat thickened proximad. It bears on its upper (adaxial) surface a double row of papillose markings which become fainter and fainter distad until they are finally entirely obsolete toward the tip of the sporophyll. These are interpreted as the cicatrices of synangia or pollen sacs of which the basal four to eight pairs appear to have been functional.

This form is of very great interest since the bulk of the described *Williamsoniæ* and all those showing any details of their organization are from very much older horizons. The present form is capable of interpretation in terms of the ordinary *Williamsonia* morphology as a single segment of the staminate disk, which may be directly compared with such well-known forms as *Williamsonia whitbiensis* so admirably restored by Nathorst.[1] A well-marked form of this type, named *Williamsonia delawarensis* by the writer, is present in the Magothy formation of Maryland and Delaware. Certain facts suggest an alternative hypothesis of the organization of this Upper Cretaceous sporophyll. These are the con-

[1] Nathorst, Kgl. Svenska Vetens.-Akad. Handl., Bd. xlvi, No. 4, 1911, pp. 9-14 (see text fig. 3).

siderably narrowed and somewhat thickened lower portion of the sporophyll; its isolated occurrence without any evidence of its having been a member of a disk; the functional pollen sacs in the proximal instead of the distal part of the series. These features all suggest that the cyclic arrangement, if present in the ancestors of *Williamsonia marylandica,* had been succeeded by a spiral arrangement which approximated the ordinary conifers or cycad strobilus rather than that organ as exemplified in the familiar *Cycadeoidea* or *Williamsonia* types of the older Mesozoic. There is the further possibility that *Williamsonia* was diœcious for if the form be considered a fragment of a foreshortened disk, it is difficult to explain the abortion of the distal pollen sacs and the development of the basal ones.

Williamsonia marylandica is relatively small, much smaller than the majority of known forms, although Halle[1] has described a still smaller form as *Williamsonia pusilla* from the Jurassic of Graham Land. It is distinguished from *Williamsonia delawarensis* Berry by its smaller size, constricted basal portion, more acuminate tip and thinner texture. There are a number of true Williamsoniæ that are deeply cleft as the present form would have to be, as for example, *Williamsonia oregonensis* Fontaine from the Oregon Jurassic or *Williamsonia virginiensis* Fontaine from the Lower Cretaceous of Virginia, and the same feature is noticeable in the allied genus *Cycadocephalus* of the Rhætic.

The only other possible interpretation of the present fossil is that it may represent some unknown coniferous type comparable with the fruiting specimens of *Palissya* described by Nathorst[2] from the Rhætic of Sweden. In any event it emphasizes the fact that the Upper Cretaceous contains many unknown gymnospermous types that await the lucky discovery of the field paleobotanist.

Occurrence.—MAGOTHY FORMATION. Little Round Bay, Anne Arundel County.

Collection.—Johns Hopkins University.

[1] Halle, Wiss. Ergeb. Schwed. Sudpolar-Exped. 1901-03, Bd. iii, Lief. xiv, 1913, p. 70, pl. vi, fig. 12.

[2] Nathorst, Kgl. Svenska Vetens.-Akad. Handl., Bd. xliii, No. 8, 1908.

WILLIAMSONIA DELAWARENSIS Berry

Plate LI, Fig. 7

Williamsonia delawarensis Berry, 1907, Johns Hopkins Univ. Circ., n. s. No. 7, p. 84, fig. 4.

Description.—Fructification stalked; the peduncle expanding above into a conical disk 1.2 cm. in diameter and bearing peripherally about ten thick and broad coriaceous bracts (staminate sporophylls ?) which are about 5 mm. in width and 2 cm. in length, pointed above and incurving. No further details can be made out from the specimens, which are not uncommon in the sandy clays of the Magothy formation near the deep cut of the Chesapeake and Delaware Canal near the Maryland-Delaware Line. The very arenaceous character of these clays renders it almost impossible to get out good specimens and the material rapidly disintegrates in drying, so that it has not been possible to secure permanent material of any great value. Cycadaceous leaves have not yet been found at this locality, although they are plentiful in the Magothy formation just to the northward in New Jersey, while they are very common in the underlying Raritan formation throughout its extent. The latter formation contains somewhat similar remains which Newberry[1] has called *Palæanthus problematicus* and which he is disposed to regard as a helianthoid flower, although recognizing the difficulty in the way of preservation of an ordinary flower of this sort and the incongruity of a Composite in the Mid-Cretaceous flora. The Delaware specimen differs chiefly in having only about half as many bracts and these correspondingly wider. A comparison with Newberry's fig. 8 will serve to bring out the resemblance of these two forms.

Hollick has described[2] a very poorly preserved and doubtful specimen from the Staten Island Cretaceous, *Williamsonia ? riesii,* which is somewhat similar to Newberry's *Palæanthus* and to undescribed specimens from Cliffwood, N. J. From the Dakota sandstones Lesquereux describes *Williamsonia elocata,*[3] a not very characteristic specimen. From the

[1] Mon. U. S. Geol. Survey, vol. xxvi, 1896, p. 125, pl. xxxv, figs. 1-9.

[2] Trans. N. Y. Acad. Sci., vol. xii, 1892, p. 10, pl. i, figs. 2, 3.

[3] Fl. Dakota Group, 1892, p. 87, pl. ii, figs. 9, 9a.

Atane beds of Greenland Heer describes *Williamsonia cretacea*,[1] of which species Seward says that the type specimens are very indistinct and unsatisfactory, but this is doubtless due to subsequent desiccation and does not impugn the accuracy of Heer's figures. *Williamsonia ? phœnicopsoides* Ward[2] from the lower Cretaceous of the Black Hills and *Williamsonia minima* Saporta[3] from the Neocomian of Portugal are both very poor and of doubtful affinities. *Williamsonia virginiensis* Fontaine,[4] found in the Patuxent formation of Virginia in the same layers with *Dioonites buchianus* is a very characteristic form and one of the best marked american Williamsoniæ. *Williamsonia ? gallinacea* Ward[5] from the Virginia Potomac and *Williamsonia ? bibbinsis* Ward[6] from the Maryland Potomac are both very poor and doubtful and very probably represent fragments of Abietites cones.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

Genus PODOZAMITES F. Braun

[In Münster, Beitr. Petref., Heft vi, 1843, p. 36]

PODOZAMITES LANCEOLATUS (L. and H.) F. Braun

Zamia lanceolata Lindley and Hutton, 1836, Fossils Fl., vol. iii, pl. cxciii.

Zamites lanceolatus F. Braun, 1840, Verzeich. Kreis.-Nat.-Samml. Bayreuth Petrefact, p. 100.

Podozamites lanceolatus F. Braun, 1843, in Münster, Beitr. Petrefactenkunde, Bd. ii, pt. vi, p. 33.

Podozamites proximans Conrad, 1869, Amer. Jour. Sci. (ii), vol. xlvii, p. 361, tf.

Podozamites lanceolatus Schimper, 1870, Pal. Végét., tome ii, p. 160.

? *Podozamites minor* Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 44, pl. xvi, fig. 8.

Podozamites lanceolatus Velenovsky, 1885, Gymn. Böhm. Kreidef., p. 11, pl. ii, figs. 11-19, 24.

---

[1] Fl. Foss. Arct., Ab. 2, vol. vi, 1882, p. 59, pl. xii, fig. 1; pl. xiii, fig. 9.

[2] 19th Ann. Rept. U. S. Geol. Survey, pt. ii, 1899, p. 668, pl. clxii, fig. 20.

[3] Fl. Foss. Port., 1894, p. 105, pl. xix, fig. 9.

[4] Mon. U. S. Geol. Survey, vol. xv, 1889, p. 273, pl. cxxxiii, figs. 5-7; pl. clxv, fig. 5.

[5] *Ibidem*, vol. xlviii, 1906, p. 485, pl. cvii, fig. 4.

[6] *Ibidem*, p. 554, pl. cxv, fig. 11.

Podozamites lanceolatus Dawson, 1886, Trans. Roy. Soc., Can., vol. iii, sec. iv, p. 6, pl. i, fig. 3.

Podozamites distantinervis Fontaine, 1890, Mon. U. S. Geol. Survey., vol. xv, 1889, p. 179 (pars).

Podozamites lanceolatus Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 28, pl. i, figs. 5, 6.

Podozamites angustifolius Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 44, pl. xiii, fig. 2 (non figs. 1, 3, 4).

Podozamites angustifolius Hollick, 1904, Bull. N. Y. Bot. Garden, vol. iii, p. 410, pl. lxxi, fig. 8.

Podozamites lanceolatus Penhallow, 1905, Summary Geol. Survey, Can., 1904, p. 9.

Podozamites lanceolatus Fontaine, 1906, in Ward, Mon. U. S. Geol. Survey, vol. xlviii, p. 110, pl. xxiv, figs. 17-20.

Podozamites pedicellatus Fontaine, 1906, in Ward, Mon. U. S. Geol. Survey, vol. xlviii, p. 532, pl. cxiv, fig. 1 (non other references).

Podozamites distantinervis Fontaine, 1906, in Ward, Mon. U. S. Geol. Survey, vol. xlviii, 1905, pp. 165, 281.

Zamia washingtoniana Fontaine, 1906, in Ward, Mon. U. S. Geol. Survey, vol. xlviii, 1905, p. 503 (pars), pl. cxi, fig. 2 (non. fig. 1).

Podozamites lanceolatus Knowlton, 1907, Smith. Misc. Coll., vol. iv, pt. i, p. 120, pl. xiv, fig. 4.

Podozamites lanceolatus Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 35, pl. ii, fig. 1.

Podozamites lanceolatus Berry, 1911, Md. Geol. Survey, Lower Cret., p. 341, pl. liii, figs. 5, 6.

Podozamites lanceolatus Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 76.

Podozamites lanceolatus Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 410.

Podozamites lanceolatus Berry, 1912, *Ibidem*, vol. xxxix, p. 391.

Description.—" Pinnis distantibus, alternis oppositisve, elongatis, basi sensim angustatis, inferioribus lanceolato-linearibus, superioribus elongato-ellipticis; nervis crebris."—Schimper, 1870.

This species is probably composite since it is hardly possible that a single species should range from the Jurassic into the Upper Cretaceous. However, the remains, which in the Cretaceous are entirely detached leaflets, furnish no characters by means of which they can be differentiated from the Jurassic type. This is also the conclusion reached by Hollick in this country and by Velenovsky in Bohemia.

Occurrence.—RARITAN FORMATION. Shannon Hill, Cecil County.

Collection.—Maryland Geological Survey.

PODOZAMITES KNOWLTONI Berry

Zamites angustifolius Eichwald, 1868, Lethæa rossica, tome ii, p. 39, pl. ii, fig. 7.

Podozamites angustifolius Schimper, 1870, Pal. Végét., tome ii, p. 160 (non Schenk, 1868).

Podozamites angustifolius Heer, 1876, Fl. Foss. Arct., Bd. iv, Ab. i, p. 36, pl. vii, figs. 8-11; pl. viii, figs. 2e, 5.

Podozamites angustifolius Heer, 1876, *Ibidem*, Ab. ii, p. 45, pl. xxvi, fig. 11.

Podozamites angustifolius Heer, 1878, *Ibidem*, Ab. ii, p. 22, pl. v, figs. 11b, 12.

Podozamites angustifolius Lesquereux, 1884, Cret. and Tert. Fl., p. 28.

Podozamites angustifolius Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 27, pl. i, fig. 4.

Podozamites augustifolius Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, 1895, p. 44, pl. xiii, figs. 1, 3, 4 (non fig. 2).

Podozamites angustifolius Moller, 1903, Kgl. Svensk. Vetensk. Akad. Handl., Bd., ix, pl. i, figs. 8-12, 17b.

Nageiopsis recurvata Fontaine, 1906, in Ward, Mon. U. S. Geol. Survey., vol. xlviii, 1905, p. 552, pl. cxvi, fig. 2 (non Fontaine, 1890).

Zamites tenuinervis Fontaine, 1906, in Ward, Mon. U. S. Geol. Survey, vol. xlviii, 1905, p. 528.

Podozamites knowltoni Berry, 1909, Bull. Torrey Bot. Club, vol. xxxvi, p. 247.

Podozamites knowltoni Berry, 1911, *Ibidem*, vol. xxxviii, p. 403.

Podozamites knowltoni Berry, 1911, Md. Geol. Survey, Lower Cret., p. 339.

Podozamites knowltoni Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 74.

Podozamites knowltoni Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 16, pl. iv, fig. 5.

Description.—" Foliolis elongato-lineali-lanceolatis, centim. 6 circiter longis, infra medium millim. 5 latis, basim versus margine inferiore subitius angustatis quam superiore, decurrentibus, sat approximatis et erecto-patentibus."—Schimper, 1870.

This species has a very wide range, both geological and geographical. It is common in the Jurassic of high latitudes in Russia (the type region), Siberia, Bornholm, and Spitzbergen. In the Lower and Upper Cretaceous indistinguishable remains are rather widely distributed. These occur in the Patapsco formation of the Potomac River Valley, the Raritan formation of New Jersey, the Black Creek formation of North and South Carolina and the Dakota group of Kansas. Whether or not they were specifically identical with the Jurassic forms cannot be proven,

although they present no character aside from difference in geological horizon to warrant their separation.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—U. S. National Museum.

PODOZAMITES MARGINATUS Heer

Plate LI, Fig. 8

Podozamites marginatus Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, fig. 10 (non Berry 1903).

Podozamites marginatus Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 44, pl. xiii, figs. 5, 6.

Podozamites marginatus Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 410.

Description.—" Pinnules rather large, varying from 15 cm. to 20 cm. in length, very variable in width, which ranges from 1.5 cm. to 3 cm., the Tuscaloosa specimens of minimum rather than maximum dimensions. Apex and base pointed, the angle dependent on the width of the pinnules. Base somewhat thickened and more or less abruptly narrowed in wide forms. Veins parallel, very fine and numerous, thirty or more in number. Texture thin but probably coriaceous.

This species was described by Professor Heer from the Atane beds of western Greenland and was illustrated by a single rather poor figure. It was afterward tentatively identified by Newberry from the middle Raritan of Woodbridge, New Jersey, and by the writer from the Tuscaloosa formation of Alabama where it is abundant. Whether these occurrences are identical with the type is not certain, although such identity is probable. The writer has recorded this same species from the Magothy formation of New Jersey,[1] but this material proves to be referable to the subsequently discovered genus *Doryanthites* of the Black Creek formation in North Carolina and homotaxial deposits in Georgia and Alabama.

The present species shows considerable similarity to the Lower Cretaceous species *Zamites tenuinervis* Fontaine, which is so common in the Patapsco formation of the Potomac River Valley.

[1] Berry, Bull. N. Y. Bot. Garden, vol. iii, 1903, p. 99, pl. xlvi, figs. 1, 3.

It is also comparable to the several nominal species of *Phyllotænia,* a monocotyledonous genus described by Saporta[1] from the Cenomanian of Portugal and compared with *Rhizocaulon, Bambusa,* etc.

Occurrence.—RARITAN FORMATION. Drum Point Railroad, Anne Arundel County.

Collection.—Maryland Geological Survey.

CONIFEROPHYTA

CLASS CONIFERAE

Order ARAUCARIALES

Family ARAUCARIACEAE

Genus DAMMARA Lamarck

[Encycl., t. ii, 1786, p. 259]

DAMMARA CLIFFWOODENSIS Hollick

Plate LIV, Fig. 3

Dammara cliffwoodensis Hollick, 1897, Trans. N. Y. Acad. Sci., vol. xvi, p. 128, pl. xi, figs. 5-8.

Dammara cliffwoodensis Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 61, pl. xlviii, figs. 8-11.

Dammara cliffwoodensis Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 69, pl. i, fig. 11.

Dammara cliffwoodensis Berry, 1911, *Ibidem*, p. 400.

Description.—" Scales kite-shaped, abruptly narrowed from above the middle downward, one and one-half inches long by one-half inch wide at the top, abruptly short mucronate pointed, provided on inner surface with numerous prominent resin glands and ducts which extend downward almost if not quite to the base."—Hollick, 1897.

This species was described from the Magothy formation of New Jersey, where it is very common, from which horizon it ranges upward into the overlying Matawan formation. Remains of this sort, closely resembling the cone-scales of the modern species of *Dammara,* are widespread and

[1] Saporta, Fl. Foss. Portugal, 1894, pp. 216, 221, pl. xxxviii, figs. 6-8, 12, 13, 21; pl. xxxix, fig. 20.

variable during the early Upper Cretaceous. Similar remains of smaller size are said by Hollick and Jeffrey to have been three-seeded, and in spite of this feature to be related structurally to the *Araucariaceæ.*

The present species is not very different and may be identical with *Dammara borealis* Heer, which ranges northward to Greenland (Atane beds) and southward to Alabama (Tuscaloosa formation).

Occurrence.—MAGOTHY FORMATION. Little Round Bay, Anne Arundel County. MATAWAN FORMATION. Cut on the W. B. & A. Railroad, three-quarters of a mile east of Millersville, Anne Arundel County.

Collection.—Maryland Geological Survey.

Genus ARAUCARIA Jussieu

[Gen. Pl., 1789, p. 413]

ARAUCARIA BLADENENSIS Berry

Plate LIV, Fig. 1

Araucaria bladenensis Berry, 1908, Bull. Torrey Bot. Club, vol. xxxv, p. 255, pls. xii, xiii, xiv, figs. 1-3.

Araucaria bladenensis Berry, 1911, *Ibidem*, vol. xxxviii, p. 405.

Araucaria bladenensis Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, pp. 19, 105, pl. iii, figs. 6, 7; pl. xix, figs. 1, 2.

Description.—Foliage dense, phyllotaxy spiral, leaves decurrent, coriaceous, ovate-lanceolate, about 1.6 cm. by 8 cm., the base rounded, apex thickened, cuspidate; veins immersed, averaging sixteen in number, straight, parallel, stomata small, in rows on ventral surface.

Leaves ranging from 1 cm. to 2.8 cm. in length by 0.5 cm. to 1.2 cm. in width, averaging 1.6 cm. by 0.8 cm., obovate in outline, with a broad rounded base narrowing abruptly and decurrent; the blade broadest about one-third of the distance from the base, above which point it narrows rapidly to a thickened cuspidate tip; phyllotaxy spiral; leaf substance represented by a thick sheet of lignite about 0.5 mm. thick, in which the veins are immersed. These veins average fourteen to sixteen in number, although occasionally there may be as many as twenty; they are stout, incurved at the base (forking not observed), becoming parallel and running directly upward until they abut against the leaf margin, *i. e.,* not

convergent toward the tip of the leaf. In spite of their hopeful megascopic appearance their microscopic structure is not preserved.

In one or two instances where the specimens are in a more argillaceous matrix it has been possible to get rather inferior specimens showing the arrangement and outlines of the stomata. These are broadly ovate in shape with very thin guard cells (at least when viewed on the surface). They are arranged in somewhat irregular rows on the ventral surface of the leaf, the number of rows between the two veins being usually four. Aside from the foregoing facts, the preservation is such that no other details can be made out.

This species is most remarkably similar to the recent *Araucaria bidwilli* of the Australian region. This resemblance in form, habit, and stomatal characters, reinforced by the occurrence of characteristic Araucarian cone-scales in the same beds at certain localities, renders the identification reasonably conclusive.

The most nearly related form seems to be *Araucarites ovatus* described by Hollick[1] from the Cliffwood clays of New Jersey, which differ merely by their larger size, absence of basal characters, and much less pointed tips; in fact, if the two were found in closer association or if in the abundant material any specimens had approached *Araucarites ovatus* in size I should be disposed to consider them as the variants of a single species. As the case stands, it would seem better to institute a new series, since the leaves in the material from the southern Coastal Plain are sufficiently and uniformly different enough to be readily recognized, and there is the further possibility that the New Jersey species may be more or less closely related to the modern genus *Dammara* rather than *Araucaria.*

A European form, which must surely be considered as a nearly related congener of *Araucaria bladenensis,* is Saporta's[2] *Araucaria toucasi* described from the Turonian of Bagnols and the Emscherian of Beausset near Toulon, France. Another similar form is *Araucaria macrophylla* described by Bozzi[3] from the Emscherian of Italy.

[1] Hollick, Trans. N. Y. Acad. Sci., vol. xvi, p. 128, pl. xii, figs. 3a, 4, 1897.
[2] Saporta, Le Monde des Plantes, p. 198, fig. 27, 1879.
[3] Bozzi, L., Boll. Soc. Geol. Ital., vol. x, 1891, p. 375, pl. xvi, figs. 1, 2.

Both are strikingly similar to the American species in every respect, and likewise closely allied, in appearance at least, to the recent *Araucaria bidwilli* of Australia.

Kerner[1] records *Pachyphyllum (Pagiophyllum) rigidum* Saporta and *Pachyphyllum (Pagiophyllum) araucarium* Saporta from the Cenomanian of Lesina, an island in the Adriatic off the coast of Dalmatia, both being originally Jurassic species from the French Corallion of Verdun. Both are very similar to the American species and are of about the same age. The probable identity of Cenomanian and Corallian species, it seems to me, is extremely doubtful, and both of Kerner's species should undoubtedly be considered as new species of *Aracauria,* and nearly related, if not identical, with such Cretaceous forms as *Araucaria bladenensis* or *Araucaria toucasi.* This species is represented by doubtfully determined detached leaves in Maryland. It is exceedingly common in and characteristic of the Black Creek formation in North Carolina. In South Carolina it is found in the extension of these beds. It is present in the lower Eutaw and later Cretaceous deposits in western Georgia and along the Chattahoochee River. Careful search has failed to discover this species in the very fossiliferous plant beds of western Alabama, of Tuscaloosa age, but it is present there is great abundance at the very base of the Eutaw deposits in Hale County.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

ARAUCARIA MARYLANDICA n. sp.

Plate LIV, Fig. 2

Description.—Cone-scales narrowly elongate-obovate in outline with an extended upturned distal acumen. Length of shaft of ovuliferous scale about 2 cm. Maximum width, which is not far from the thickened distal end, about 8 mm. to 10 mm. Minimum width, at proximal end, about 5 mm. Acuminate upturned tip about 6 mm. in length and 2.5 mm. broad at the base. Lateral margins of scale straight nearly to the thick-

[1] Kerner, Jahrb. k.k. Geol. Reichs., Bd. xlv, 1895, p. 49, pl. iv, figs. 1, 3.

ened end where they curve inward, recurving to form the acuminate tip. The ligule is prominent on the upper (ventral) surface of the scale to its base, is somewhat thickened, and conforms in its outline to that of the scale; its distal margins are entire, and it ends medianly in a short mucronate point. The enclosed seed is oblong-obovate with straight lateral margins and rounded ends.

The present species is clearly distinct from the rather numerous Araucarian remains that have been described from the Upper Cretaceous of the Atlantic Coastal Plain. It is associated in Maryland with meagerly represented foliage of *Aracauria blandenensis* Berry, an exceedingly abundant and well characterized form of the *Araucaria bidwilli* type, which is very common in the Black Creek formation of the Carolinas and the Eutaw formation of Georgia and Alabama. In the region of its maximum abundance from North Carolina to Alabama *Araucaria bladenensis* is uniformly associated with the large cone-scales described as *Araucaria jeffreyi* Berry, and it has seemed very probable that they represented the foliage and ovulate scales of the same Cretaceous tree. *Araucaria jeffreyi* is a much larger, relatively wider and otherwise very different type of sporophyll from *Araucaria marylandica.* At the same horizon as the latter species of cone-scale in the New Jersey region there occurs foliage described as *Araucarites ovatus* Hollick, which may be related to the former.

Among recent species there is some resemblance to *Araucaria rulei,* a New Caledonian species of the Eutacta section of *Araucaria,* but on the whole the present fossil form is more like the sporophylls of the Colymbea section of the genus, especially those of *Araucaria imbricata,* the so-called Chile pine.

Occurrence.—MAGOTHY FORMATION. Little Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Family BRACHYPHYLLACEAE

Genus BRACHYPHYLLUM Brongniart

[Prodrome, 1828, p. 109]

BRACHYPHYLLUM MACROCARPUM Newberry

Plate LIV, Figs. 4, 5

Moriconia cyclotoxon Heer, 1883, Fl. Foss. Arct., Bd. vii, pl. liv, fig. 1c (non Heer's other figures).

Thuites crassus Lesquereux, 1884, Cret. and Tert. Fl., p. 32.

Brachyphyllum crassum Lesquereux, 1887, Proc. U. S. Nat. Mus., vol. x, p. 34. p. 34.

Brachyphyllum crassum Lesquereux, 1892, Fl. Dakota Group, p. 32, pl. ii, fig. 5.

Brachyphyllum crassum Newberry, 1896, Fl. Amboy Clays, p. 51, pl. vii, figs. 1-7.

Brachyphyllum macrocarpum Newberry, 1896, Fl. Amboy Clays, Ms. name mentioned in footnote, p. 51.

? *Brachyphyllum sp.* Knowlton, 1897, Bull. Geol. Soc. Amer., vol. viii, pp. 137, 140.

? *Brachyphyllum macrocarpum* Knowlton, 1900, Bull. U. S. Geol. Survey, No. 163, p. 29, pl. iv, figs. 5, 6.

Brachyphyllum macrocarpum Hollick, 1904, Bull. N. Y. Bot. Garden, vol. iii, p. 406, pl. vii, figs. 4, 5.

Brachyphyllum macrocarpum Berry, 1905, Bull. Torrey Bot. Club, vol. xxxii, p. 44, pl. ii, fig. 9.

Brachyphyllum macrocarpum Berry, 1906, *Ibidem*, vol. xxxiii, p. 168, pl. ix.

Brachyphyllum macrocarpum Berry, 1906, Ann. Rept. State Geol. Survey of New Jersey for 1905, p. 139.

Brachyphyllum macrocarpum Hollick and Jeffrey, 1906, Amer. Nat., vol. xl, p. 200.

Brachyphyllum macrocarpum Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 44, pl. iii, figs. 9, 10.

Brachyphyllum macrocarpum Berry, 1911, Bull. 3, New Jersey Geol. Survey, p. 81, pl. vii.

Brachyphyllum macrocarpum Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 21, pl. iii, fig. 2.

Description.—Stout twigs with club-shaped, pinnately arranged branches, covered with large, thick, rhomboidal, squamate, densely crowded, appressed leaves attached by practically their whole ventral surface. Phyllotaxy spiral. Leaf more or less striated, the striæ converging toward the obtuse papillate apex. Cones not positively determined.

Brachyphyllum is chiefly an older Mesozoic type, but it remains abundant through the Lower Cretaceous, two species having been described from the Potomac group of Maryland and Virginia. It is a waning type in the Upper Cretaceous represented by but a single species, the one under discussion, and the following variety, which persist as high as the Senonian. Both are widely distributed, and the type is recorded from Long Island, New Jersey, Delaware, Maryland, and South Carolina, and from the Dakota group of Kansas and the Montana group of Wyoming in the West. It is probably represented in the Patoot beds of Greenland by the material which Heer erroneously refers (*loc. cit.*) to *Moriconia*. While it is not recorded from Europe, Velenovsky has described remains from the Cenomanian of Bohemia which appear to be identical with the American representatives of this species, referring them to the Jurassic genus *Echinostrobus* of Schimper.[1]

Hollick and Jeffrey have recently argued from a study of specimens from Staten Island with structure preserved (*loc. cit.*), that this species is related to the family *Araucariaceæ*.

This species is extremely common in the upper Raritan beds at South Amboy, New Jersey, and their eastward extension on Staten Island, but has not been collected from any of the plant-bearing horizons of the lower Raritan. Professor Newberry described (*loc. cit.*) large cones which he found associated with these twigs, and which he thought were related to them, although this seems improbable. The cones are poorly preserved and their affinities cannot be made out. They are very different from previously described cones of *Brachyphyllum*, and the work of Hollick and Jeffrey (*loc. cit.*) would seem to indicate that the present species had small cones. The cones described by Professor Newberry, while they are here retained in the synonymy of this species, are comparable to the abundant cones from the older Potomac of Maryland which are referred to the form-genus *Abietites*. No cones have been positively found associated with the not uncommon occurrences of this species.

[1] Velenovsky, Gym, Böhm. Kreidef., 1885, p. 16, pl. vi, figs. 3, 6-8; Květena českého cenomanu, 1889, p. 9, pl. i, figs. 11-19; pl. ii, figs. 1-3.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County, Maryland.

Collection.—U. S. National Museum.

BRACHYPHYLLUM MACROCARPUM FORMOSUM Berry

Plate LIII, Fig. 1

Brachyphyllum macrocarpum Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 183 (non Newberry, 1896).

? *Brachyphyllum macrocarpum* Berry, 1911, *Ibidem*, vol. xxxviii, p. 420.

Brachyphyllum macrocarpum formosum Berry, 1912, Ibidem, vol. xxxix, p. 392, pl. xxx.

Brachyphyllum macrocarpum formosum Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 106.

Description.—Slender elongated twigs, pinnately branched, covered with medium sized, crowded, appressed leaves, spirally arranged. Leaves bluntly pointed, smooth, thick.

In the consideration of the various specimens which have been referred to *Brachyphyllum macrocarpum*, a very considerable variation within certain fixed limits is at once obvious. This variation is usually one of size, the more slender specimens being at the same time smoother. This has been frequently noted by the writer and is commented upon in print by Dr. Knowlton,[1] who in discussing the younger forms from Wyoming suggests that the species on the verge of extinction became smaller in its proportions. In studying the material from the South Atlantic and Gulf states a constant difference in size was noticed. This may reflect a slight difference in climatic conditions and all of the forms may be interpreted as the variations of a single species; in fact, Newberry's fig. 7 (*loc. cit.*) from the Raritan formation in New Jersey is approximately the same size as the forms from the Montana group of the West and is associated with the normal, stout club-shaped type. That the variety has no particular stratigraphic significance is indicated by its abundance at a horizon as old as the basal Tuscaloosa of Alabama, and its presence in the Woodbine formation of Lamar County, Texas.

[1] Knowlton, Bull. U. S. Geol. Survey, No. 163, 1900, p. 29, pl. iv, figs. 5, 6.

In general the present variety occurs at later and more southern horizons than the type, which might be ascribed to the fact that only the slender terminal twigs are preserved. This is regarded as improbable, however, since the same reasoning should hold good for the areas where only thicker twigs have been found.

The remains are usually much macerated and broken and the immediate cause for the recognition of a new variety was the discovery of a relatively large specimen from the Magothy formation of Maryland, which showed such striking unlikeness to the type that separation was demanded and specific differentiation was even considered. In view, however, of the occurrence of both forms in association in Maryland and the well-known variation of not only the type, but of coniferous foliage in general, it seemed wiser to consider the present as a variety of the type, which as time progressed supplanted it to a large extent, if not altogether.

The new specimen from Maryland shows the terminal part of two approximately parallel and curved twigs about 12 cm. in length, united proximad. These in their largest portion are only 6 mm. in diameter. At intervals of from 3 mm. to 5 mm. subopposite lateral branches are given off in a pinnate manner. These are relatively much elongated, curved, and slender, averaging about 4 cm. in length by 2 mm. in diameter, bluntly pointed and not tapering to any appreciable extent. These have been occasionally observed to fork pseudo-dichotomously and at times they give off toward their distal ends tiny lateral branchlets less than a centimeter in length and about a millimeter in diameter.

The general proportions are thus decidedly different from the supposed parent type. The leaves are slightly smaller and smoother and somewhat more elongated in their relative proportions, at the same time lacking the apical papilla and the convergent striæ. The form is much more graceful in appearance, and in its general aspect suggests the Lower Cretaceous genus *Arthrotaxopsis* of Fontaine.

While tiny species of *Brachyphyllum* like *Brachyphyllum microcladum* Saporta of the Neo-Jurassic have been described, the new variety is even more slender than *Brachyphyllum gracile* Brongniart of the Jurassic. The most closely allied form known appears to be one from the Albian of

Buarcos in Portugal described by Saporta[1] as *Brachyphyllum obesiforme elongatum*. There is also considerable resemblance to *Brachyphyllum crassicaule* Fontaine of the Patapsco formation in Maryland and Virginia.

The present variety is abundant throughout the Tuscaloosa formation and in the basal part of the Eutaw formation in Alabama and western Georgia, and occurs also in the Woodbine formation of Texas, but is known only from a single locality in Maryland.

Occurrence.—MAGOTHY FORMATION. Sullivan's Cove, Round Bay, Anne Arundel County.

Collection.—Johns Hopkins University.

Order PINALES

Family PINACEAE

Genus SEQUOIA Endlicher

[Synop. Conif., 1847, p. 197]

SEQUOIA HETEROPHYLLA Velenovsky

Plate LIII, Fig. 2; Plate LIV, Fig. 7

Sequoia heterophylla Velenovsky, 1885, Gymnos. Böhm. Kreidef., p. 22, pl. xii, fig. 12; pl. xiii, figs. 2-4, 6-9.

Sequoia heterophylla Velenovsky, 1888, Sitz. k. Böhm. Gesel. Wiss., Prag., p. 593, figs. 7, 8.

Sequoia heterophylla Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xii, p. 3, pl. i, fig. 18.

Sequoia heterophylla Ward, 1895, 15th Ann. Rept. U. S. Geol. Survey, pp. 378, 380, 392.

Sequoia heterophylla Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 49, pl. vi, figs. 1-13.

Sequoia heterophylla Knowlton, 1905, Bull. U. S. Geol. Survey, No. 257, p. 132, pl. xvi, fig. 5.

Sequoia heterophylla Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 165.

Sequoia heterophylla Berry, 1906, Ann. Rept. State Geol. of New Jersey for 1905, p. 139.

Sequoia heterophylla Berry, 1907, Bull. Torrey Bot. Club, vol. xxxiv, p. 189.

Sequoia heterophylla Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 41, pl. iii, figs. 2, 3.

Sequoia heterophylla Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 95, pl. vi.

---

[1] Saporta, Fl. Foss. Portugal, 1894, p. 176, pl. xxxi, fig. 14.

Description.—This characteristic species, described originally from the Cenomanian of Bohemia, may be readily recognized by the form of the foliage—the flat, lanceolate, decurrent leaves above, and the short and appressed leaves below. Newberry says of this species that it is one of the most common conifers of the Amboy clays, but mentions no localities. The writer has only found it in the Upper Raritan at South Amboy, New Jersey, where it is very common, and at the Hylton pits, which are also near the top of the Raritan, and it has been collected by Hollick from a probably equivalent horizon at Kreischerville, Staten Island.

In the overlying Magothy formation it is a common species with a recorded range from Marthas Vineyard to Maryland, and in the allied Black Creek formation of North Carolina. It occurs in the Tuscaloosa formation of Alabama and in the West it occurs in the Judith River beds of Montana. The form described by Newberry from the Cretaceous of Nanaimo, Vancouver Island, as *Sequoia cuneata* is very similar to the present species.

In 1888 (*op. cit.*) Velenovsky described additional twigs of this species and cones from the Cenomanian of Hloubetin, Bohemia, although he does not state that they were attached. The cones were of small size 2.3 cm. by 1.5 cm., elliptical in outline, and were made up of a relatively small number of slender, rhomboidal, umbilicate scales of *Sequoia* type.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Litte Round Bay, Anne Arundel County.

Collections.—Maryland Geological Survey, U. S. National Museum.

SEQUOIA AMBIGUA Heer

Sequoia ambigua Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, pp. 78, 91, pl. xxi, figs. 1-11; pl. xxv, fig. 5.

Sequoia ambigua Heer, 1882, *Ibidem*, Bd. vi, Ab. ii, pp. 17, 52, pl. i, fig. 3.

Sequoia ambigua Bozzi, 1888, Atti Soc. Ital. Sci. Nat., vol. xxxi, p. 401, pl. vi, fig. 2.

Sequoia ambigua Fontaine, 1890, Mon. U. S. Geol. Survey, vol. xv, 1889, p. 245, pl. cxviii, fig. 2; pl. cxx, figs. 1-6; pl. cxxvii, fig. 5; pl. cxxxii, fig. 3.

Sequoia ambigua White, 1890, Am. Jour. Sci., vol. xxxix, p. 97, pl. ii, figs. 2, 3.

Sphenolepidium recurvifolium Fontaine, 1890, Mon. U. S. Geol. Survey, vol. xv, 1889, p. 258, pl. cxxvii, fig. 2; pl. cxxx, figs. 2, 7.

Sphenolepidium dentifolium Fontaine, 1890, Mon. U. S. Geol. Survey, vol. xv, 1889, p. 258, pl. cxxviii, figs. 2-6; pl. cxxix, fig. 6; pl. cxxx, figs. 4-6, 10.

Sequoia ambigua Bozzi, 1891, Bol. Soc. Geol. Ital., vol. x, p. 373, pl. xv, fig. 4.

Sequoia ambigua Nathorst, 1893, in Felix and Lenk, Beitr. z. Geol. u. Päl. Repub. Mexico, ii Theil, 1 Heft, p. 51, figs. 1-3.

Sequoia ambigua Hollick, 1895, Bull. Geol. Soc. Am., vol. vii, p. 13.

Sequoia gracilis Fontaine, 1899, in Ward, 19th Ann. Rept. U. S. Geol. Survey, pt. ii, p. 675, pl. clxvi, fig. 2 (non Heer).

Sequoia ambigua Uhler, 1901, Trans. Md. Acad. Sci., vol. i (1892), p. 207.

Sequoia ambigua Fontaine, 1906, in Ward, Mon. U. S. Geol. Survey, vol. xlviii, 1905, pp. 272, 281, 538, 555, pl. lxix, fig. 6; pl. cx, fig. 13.

Sphenolepidium dentifolium Fontaine, 1906, in Ward, Mon. U. S. Geol, Survey, vol. xlviii, 1905, pp. 484, 528, 538, 546, 555.

Arthrotaxopsis expansa Fontaine, 1906, in Ward, Mon. U. S. Geol. Survey, vol. xv, 1889, pp. 533, 535, 538, 555, 573, pl. cix, figs. 12, 13 (non pp. 504, 520, 547, 571).

Sequoia ambigua Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 41, pl. iii, figs. 7, 8.

Sequoia ambigua Knowlton, 1907, Smith. Misc. Coll., vol. iv, pt. i, 1907, p. 126.

Sequoia ambigua Berry, 1910, Bull. Torrey Club, vol. xxxvii, p. 20.

Sequoia ambigua Berry, 1911, Proc. U. S. Natl. Mus., vol. xl, p. 310.

Sequoia ambigua Berry, 1911, Md. Geol. Surv., Lower Cretaceous, p. 449, pl. lxxviii, figs. 1-7.

Description.—"S. ramis elongatis, foliis omnino tectis, ramulis alternis, gracilibus, foliis decurrentibus, brevibus, crassiusculis, falcato-incurvis, apice acuminatis, uninerviis, strobilis globosis, squamis peltatis, planiusculis."—Heer, 1874.

Remains of the foliage of this species are distinguishable from those of contemporaneous conifers, which occur in the beds with them, by the relatively short and very stout, acuminate, falcate or recurved, decurrent leaves.

The cones are spheroidal and consist of relatively few, short scales with longitudinally striated peduncles and suddenly expanded, quadrangular, peltate, umbilicate tips. These cones are abundant in the Lower Cretaceous of Maryland, occurring usually as detached ferruginized mud casts, and are fully described in the writer's account of the Lower Cretaceous flora of Maryland.

As recorded in the literature cited above, *Sequoia ambigua* is widely distributed geographically and it has an equally great geological range.

Described originally from the Kome beds (Urgonian) of Greenland by Professor Heer, this author soon afterward recorded it from the Upper Cretaceous Atane beds of that country. It has been recorded by Nathorst from the Neocomian of Mexico and it is present in the Kootenai formation of Montana. It is a member of the Shasta flora of the Pacific Coast (Horsetown beds), and is probably represented in the Fuson formation of eastern Wyoming by what Professor Fontaine calls *Sequoia gracilis*. In the Upper Cretaceous, remains in every way identical with these Lower Cretaceous occurrences are present in the Magothy formation at Gay Head, Marthas Vineyard, and in Maryland, as well as in the Tuscaloosa formation of Alabama. A similar occurrence is that in the Emscherian of Italy recorded by Bozzi (*op. cit.*). After much comparison and study the writer is unable to formulate good characters for the separation of the later from the earlier Cretaceous forms that have been referred to this species.

The Upper Cretaceous forms resemble greatly some of the homotaxial remains referred by Heer and others to *Sequoia subulata* Heer and to *Sequoia fastigiata* (Sternb.) Heer. They are, however, different from the types of both these species, and it seems probable that the later identifications include diverse species under these names. The fragments figured in 1876 by Lesquereux from the Dakota group as *S. fastigiata* are also quite similar to the eastern remains referred to *Sequoia ambigua*.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

SEQUOIA REICHENBACHI (Geinitz) Heer[1]

Araucarites reichenbachi Geinitz, 1842, Charakteristik d. Schichten u. Petrefacten sachs.-böhm. Kreide, Heft iii, p. 98, pl. xxiv, fig. 4.

Cryptomeria primæva Corda, 1846, in Reuss, Versteinerungen böhm. Kreidef., Ab. ii, p. 89, pl. xlviii, figs. 1-11.

---

[1] Three citations, involving a change in the specific name of this well-known form, are here omitted as being too uncertain: *Conites familiaris* Sternberg, *Bergeria minuta* Presl, and *Sedites ? rabenhorstii* Geinitz. A complete synonymy of this species has been given in the writer's account of the Lower Cretaceous flora of Maryland. After giving the earlier names, only Upper Cretaceous citations are given in the present connection.

Pinus exogyra Corda, 1846, in Reuss, *Ibidem*, p. 91, pl. xlviii, figs. 16-18.
Geinitzia cretacea Endlicher, 1847, Syn. Conif., p. 281.
Pinites exogyrus Endlicher, 1847, *Ibidem*, p. 284.
Araucaria reichenbachi Debey, 1849, Entwurf. z. e. Geogn.-Geogenst. Darst. d. Gegend v. Aachen (Nachträge), p. 63.
Cryptomerites primævus Brongniart, 1849, Tableau, p. 74.
Piceites exogyrus Göppert, 1850, Mon. Fossils Conif., p. 208.
Cycadopsis cryptomerioides Miquel, 1853, Verh. Geol. Kaart. v. Nederl., Deel i, p. 42 (10), pl. iii.
Araucarites appressus v. d. Marck, 1863, Pal., Bd. xi, p. 80, pl. xiii, figs. 10, 11.
Sequoia reichenbachi Heer, 1868, Fl. Fossils Arct., Bd. i, p. 83, pl. xliii, figs. 1d, 2b, 5a.
Sequoia reichenbachi Heer, 1869, Kreidefl. v. Quedlinburg, p. 9, pl. i, fig. 2 (Neue Denks. schweiz. Gesell. Naturw., Bd. xxiv).
Sequoia reichenbachi Heer, 1872, Fl. v. Moletein in Mähren, p. 7, pl. i, figs. 1-9 (Neue Denks. schweiz. Gesell. Naturw., Bd. xxiii, Mém. ii).
Sequoia reichenbachi Lesquereux, 1874, Cret. Fl., p. 51, pl. i, figs. 10, 10a, 10b.
Sequoia reichenbachi Heer, 1874, Fl. Fossils Arct., Bd. iii, Ab. ii, pp. 77, 101, 126, pl. xii, figs. 7c, 7d; pl. xx, figs. 1-8; pl. xxviii, fig. 2; pl. xxxiv, fig. 1; pl. xxxvi, figs. 1-8; pl. xxxvii, figs. 1, 2.
Abietites dubius Lesquereux, 1878, Tert. Fl., p. 81, pl. vi, figs. 20, 21, 21a.
Sequoia reichenbachi Hosius and v. d. Marck, 1880, Pal., Bd. xxvi, pp. 132, 179, pl. xxxvii, figs. 145, 146.
Sequoia reichenbachi Heer, 1882, Fl. Fossils Arct., Bd. vi, Ab. ii, p. 52, pl. xxviii, fig. 7.
Sequoia reichenbachi Dawson, 1882, Trans. Roy. Soc. Can., p. 21.
Sequoia reichenbachi Velenovsky, 1885, Gymn. böhm. Kreidef., p. 19, pl. viii, figs. 8, 9; pl. ix, figs. 5, 5a, 6a, 7a, 10a, 12, 12a, 13, 14.
Sequoia couttsiæ Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xii, p. 30, pl. i, fig. 5 (non Heer).
Sequoia reichenbachi Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xii, p. 30, pl. i, fig. 18.
Sequoia reichenbachi Lesquereux, 1892, Mon. U. S. Geol. Surv., vol. xvii, p. 35, pl. ii, fig. 4.
Sequoia reichenbachi Smith, 1894, Geol. Coastal Plain in Ala., p. 348.
Sequoia reichenbachi Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, 1895, p. 49, pl. ix, fig. 19.
Sequoia reichenbachi Krasser, 1896, Kreidefl. v. Kunstadt in Mahren, Palæont. Oest. Ung. u. d. Orients, Bd. x, p. 124.
Sequoia reichenbachi Knowlton, 1899, Mon. U. S. Geol. Survey, vol. xxxii, p. 657.
Sequoia reichenbachi Berry, 1903, Bull. N. Y. Bot. Gard., vol. iii, p. 59, pl. xlviii, figs. 15-18, 20.
Sequoia reichenbachi Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 69, pl. iv, fig. 8.
Sequoia reichenbachi Berry, 1905, Bull. Torrey Bot. Club, vol. xxxii, p. 44, pl. i, fig. 3.

Sequoia reichenbachi Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, 1906, p. 165.

Sequoia reichenbachi Berry, 1906, Rept. State Geol. (N. J.), for 1905, p. 139.

Sequoia reichenbachi Hollick, 1906, Mon. U. S. Geol. Survey, vol. l, p. 42, pl. ii, fig. 40; pl. iii, figs. 4, 5.

Sequoia reichenbachi Berry, 1910, Bull. Torrey Club, vol. xxxvii, p. 20.

Sequoia reichenbachi Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 93.

Sequoia reichenbachi Berry, 1911, Md. Geol. Surv., Lower Cretaceous, p. 444, pl. lxxvii, fig. 7.

Sequoia reichenbachi Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84. pp. 23, 107, pl. iv, figs. 1-4.

Description.—" S. ramis elongatis, foliis decurrentibus, patentibus, falcato-incurvis, rigidis, acuminatis."—Heer, 1869.

This is one of the most wide-ranging fossil plants, both geologically and geographically, that is known, and it seems very probable that is is of a composite character, the well-known difficulty in distinguishing between coniferous twigs of this character prohibiting any satisfactory segregation. Described originally as a species of *Araucarites,* certain of these remains from the Staten Island Cretaceous have shown by their vascular structure that they are related to the *Araucarieæ,* while on the other hand a large number of exactly similar remains of leaf-bearing twigs bore cones which are unquestionably those of *Sequoia.* Twigs of this sort are abundant throughout the Potomac group, occurring also in the Fuson formation of the Black Hills, the Kootenai of Montana, the Shasta of California, the Kome beds of Greenland, and the Neocomian of Central Mexico. Abroad they have been reported from the Upper Jurassic (?) of Portugal, the Neocomian of Belgium, the Barremian of Silesia, and the Albian of Switzerland.

As might be expected from their great range, fossils of the *Sequoia reichenbachi* type are of slight stratigraphic value, nevertheless the remains are very abundant from New Jersey to Alabama at the Magothy-Black Creek-Middendorf-Tuscaloosa-Eutaw horizons, apparently identical in character and frequently cone-bearing, the cones being small, prolate spheroids in shape, and consisting of relatively few, peltate, umbilicate, Sequoia-like scales. Sequoia twigs are very resistant to maceration, and frequently are about the last vegetable remains to disintegrate in marine waters. This species is rare in the Raritan formation of New Jersey and is unknown in the Maryland Raritan. It is common at later Upper Cre-

taceous outcrops in New Jersey, Delaware, Maryland (foliage and cones), North Carolina, South Carolina, Georgia, and Alabama.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Round Bay and Little Round Bay, Anne Arundel County, Maryland.

Collection.—Maryland Geological Survey.

Genus CUPRESSINOXYLON Gœppert (?)

[Mon. Foss. Conif., 1850, p. 196]

CUPRESSINOXYLON ? BIBBINSI Knowlton

Cupressinoxylon ? bibbinsi Knowlton, 1896, Science, n. s., vol. iii, pp. 582-584, tf. 1-4.

Description.—This species was based on sections of poorly preserved lignite from the type locality of the Magothy formation at Cape Sable. The wood cells are almost obliterated by crushing: the radial sections show the walls to have been thick and with a single interrupted series of large bordered pits; the rays, as shown in tangential sections, are crushed, but appear to have been uniseriate and of about four cells.

The material upon which this species is founded is much too incomplete for even successful generic determination. The genus *Cupressinoxylon* to which it has been referred was discussed by the writer in a previous report[1] and need not be amplified in the present connection.

Occurrence.—MAGOTHY FORMATION. Cape Sable, Magothy River, Anne Arundel County.

Collections.—U. S. National Museum, Goucher College.

Subfamily CUPRESSEAE

Genus THUJA Linné

[Sp. Pl. 1753, p. 1002]

THUJA CRETACEA (Heer) Newberry

Libocedrus cretacea Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 49, pl. xxix, figs. 1-3; pl. xliii, fig. 1d.

Thuja cretacea Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 53, pl. x, figs. 1, 1a.

[1] Berry, E. W., Md. Geol. Survey, Lower Cretaceous, 1911, pp. 413-415.

Thuja cretacea Knowlton, 1905, Bull. U. S. Geol. Survey, No. 257, p. 133, pl. xvi, figs. 3a.
Thuja cretacea Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 169.

Description.—" L. ramulis gracilibus, oppositis, compressis, foliis quadrifariam, facialibus rhombeis, minutis, dorso argute carinatis."—Heer, 1882.

This species was described originally from the Atane beds of Greenland as a species of *Libocedrus*. When Professor Newberry came to study the abundant remains from the Upper Raritan he changed the generic reference to *Thuja* on what appears to be good evidence. Similar remains have been identified by Knowlton from the Judith River beds of Montana, and the writer has noted identical remains in considerable abundance in the Magothy formation of Delaware and Maryland.

The twigs are strap-shaped with nearly parallel sides 2 mm. or slightly less in width and with four rows of short appressed leaves.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

Genus JUNIPERUS Linné
[Sp. pl., 1753, p. 1038]

JUNIPERUS HYPNOIDES Heer

Juniperus hypnoides Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 47, pl. xliv, fig. 3; pl. xlvi, fig. 18.
Juniperus hypnoides Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xii, p. 22, pl. i, fig. 1.
Juniperus macilenta Newberry, 1896, Mon. U. S. Geol, Survey, vol. xxvi, p. 54, pl. x, fig. 7.
Juniperus hypnoides Hollick, 1902, Bull. N. Y. Bot. Garden, vol. ii, p. 403, pl. xli, fig. 7, 7a.
Juniperus hypnoides Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 168.
Juniperus hypnoides Berry, 1906, Ann. Rept. State Geol. of New Jersey for 1905, p. 139.
Juniperus hypnoides Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 46, pl. ii, figs. 26 *(ex parte)*, 27b, 28; pl. iii, figs. 12-13a.

Description.—" J. multiramosa, ramulis tenuissimis, congestis, foliis oppositis, falcatis, apice acuminatis, uninerviis, 1 mm. longis."—Heer, 1882.

This conifer which is a common one in the Raritan was referred by Professor Newberry to *Juniperus macilenta* Heer, although if the two species are to be kept separate, a not altogether certain proposition, it is clearly more closely allied to *Juniperus hypnoides,* under which Hollick has already placed it (*loc. cit.,* 1907). Professor Newberry describes its association at Woodbridge with *Dammara* scales and was evidently of the opinion that the one was the fruit of the other. Material in the New York Botanical Garden shows this association which is probably, however, purely a mechanical one. The type material came from the Atane beds of Greenland, and additional remains are also abundant in the Raritan of Kreischerville, Staten Island and in the Magothy formation of Marthas Vineyard, New Jersey and Delaware.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

Genus WIDDRINGTONITES Endlicher

[Synop. Conif., 1847, p. 271]

WIDDRINGTONITES REICHII (Ettingshausen) Heer[1]

Plate LV, Fig. 1

Frenelites reichii Ettingshausen, 1867, Kreidefl. von Niederschœna, p. 12 (246), pl. i, figs. 10a-10c.

Glyptostrobus gracillimus Lesquereux, 1868, Amer. Jour. Sci (ii), vol. xlvi, p. 92.

Glyptostrobus gracillimus Lesquereux, 1874, Cret. Fl., p. 52, pl. i, figs. 8, 11-11f.

Widdringtonites reichii Heer, 1882, Fl. Foss. Arct., vol. vi, Ab. ii, p. 51, pl. xxviii, fig. 5.

Glyptostrobus gracillimus Lesquereux, 1883, Cret. & Tert. Fl., p. 32, pl. i, figs. 6-6b.

Widdringtonites reichii Heer, 1883, Fl. Foss. Arct., vol. vii, p. 13, pl. lii, figs. 4, 5.

Widdringtonia reichii Velenovsky, 1885, Gym. bohm. Kreidef., p. 27, pl. viii, figs. 4-6; pl. x, figs. 1, 11, 12.

[1] The following earlier citations are included under this species by Ettingshausen: *Lycopodites insignis* Reich, in Geinitz, Charak. der Schichten u. Petrefacten sachsböhm. Kreidegebirges, p. 98, 1842; Bronn. Lethæa geogn., p. 577, pl. xxviii, fig. 13, 1846. They are omitted in the present connection since if they are positively identified as this species it would involve changing the name of this widespread and well-known form.

Widdringtonia reichii Velenovsky, 1887, Sitz. k. böhm. Gesell. Wiss., 1886, p. 639, pl. i, figs. 14-16.

Widdringtonia reichii Engelhart, 1891, Isis, Ab. 7, p. 92.

Frenelites reichii Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xii, p. 29, pl. i, fig. 23.

Glyptostrobus gracillimus Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 38.

Widdringtonites reichii Smith, 1894, Geol. Coastal Plain Ala., p. 348.

Sequoia gracillima Smith, 1894, *Ibidem (nomen nudum)*.

Sequoia gracillima Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, 1895, p. 50, in part (non pl. ix, figs. 1-3).

Widdringtonites reichii Newberry, 1896, *Ibidem*, p. 57, pl. viii, figs. 1-5.

Widdringtonia reichii Krasser, 1896, Beitr. Pal. Oest. Ung. u. Orients, Bd. x, p. 126 (14), pl. xiv (iv), fig. 6; pl. xvii (vii),, figs. 4, 7, 8.

Sequoia gracillima Newberry, 1898, Mon. U. S. Geol. Survey, vol. xxxv, p. 19 *(ex parte)*, pl. xiv, fig. 6 (non pl. xxvi, fig. 9).

Widdringtonia reichii Marik, 1901, Prispevek k. fl. ceskeho cenomanu, p. 9, pl. i, fig. 23; pl. ii, fig. 2.

Widdringtonites reichii Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 169.

Widdringtonites reichii Berry, 1906, Rept. State Geol. of New Jersey for 1905, p. 138.

Widdringtonites reichii Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 44, pl. iv, figs. 6-8.

Widdringtonites reichii Hollick and Jeffrey, 1909, Mem. N. Y. Bot. Garden, vol. iii, p. 29, pl. v, figs. 1-4; pl. viii, figs. 7-11; pl. xx, figs. 3-5.

Widdringtonites reichii Berry, 1910, Bull. Torrey Bot. Club, vol. xxxviii, p. 21.

Widdringtonites reichii Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 87, pl. viii, figs. 1, 2.

Description.—" F. ramis suberectis fastigiatis, ramulis filiformibus confertis, foliis appressis e basi ovata subulatis, strobilis axillaribus duplo longioribus quam latis."—Ettingshausen, 1867.

Medium-sized branches with more or less crowded, slender, elongated, fastigiate twigs, bearing reduced ovate-subulate leaves, spirally arranged. Both microsporangiate and megasporangiate cones have been found. The cones are small oval bodies 5 mm. to 12 mm. long by 3 mm. to 7 mm. in diameter, usually poorly preserved, said by Ettingshausen to be axillary in position but evidently often terminal, as evinced by some of the Raritan material as well as by some of the better preserved cones from the Cenomanian of Bohemia and Moravia. The latter material clearly shows that the cones consisted of four scales. This would ally it with either the

subgenus *Widdringtonia* of the genus *Callitris* Vent., to which Eichler in his treatment of the living species in Engler and Prantl (1887) refers Endlicher's genus, or to the subgenus *Eucallitris* Brongn., which also is characterized by four cone-scales. The latter has a single living species of northern Africa and the former has three or four species of southern Africa and Madagascar. The propriety of Eichler's classification may well be questioned, and in any event paleobotanists must necessarily prefer the older segregation of *Frenela* and *Widdringtonia* and their respective form-genera.

There seems to be but little doubt that the present species should be referred to *Widdringtonia,* as Velenovsky and Krasser have done, but as the term *Widdringtonites* is equally indicative of its true affinity, little is to be gained by making the proposed change.

This species, which is probably the most common conifer of the Raritan formation, was described originally by Ettingshausen from the Cenommanian of Niederschœna, in Saxony, as a species of *Frenelites.* When Heer discovered it in the Greenland material, where it has been collected from both the Atane and the Patoot beds, he transferred it to the present genus. It has subsequently been reported from the Cenomanian of Bohemia and Moravia, from the Magothy formation at numerous localities and from the southern New England islands. It has also been reported from the Tuscaloosa formation of Alabama, where it is abundant at a number of localities. Heer made *Glyptostrobus gracillimus* Lesq., of the Dakota group, a synonym of this species, and he has been followed by many subsequent authors.

In a recent paper Hollick and Jeffrey (*op. cit.*) have studied the anatomy of fragments of twigs from the Raritan formation of Staten Island, New York. They are led to claim a relationship with the *Araucariaceæ* for this form. This is not at all conclusively shown by the specimens studied and even were this evidence admitted for this material it would scarcely affect the question of relationship of the great bulk of the remains referred to *Widdringtonites* or *Widdringtonia,* since Ettingshausen and Krasser (*op. cit.*) have conclusively shown the relationship with *Widdringtonia* by means of the megasporangiate cones. While these

have not been found in organic union with the leafy twigs in the American material, attached cones of this type have been found by the writer[1] in the closely related species *Widdringtonites subtilis* Heer.

Widdringtonites reichii is closely allied to and descended from, if not identical with, a common conifer of the Patapsco formation of Maryland and Virginia described by the writer[2] as *Widdringtonites ramosus,* and based upon *Taxodium ramosum* and various other species of Professor Fontaine's Flora of the Potomac Group.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Round Bay, Anne Arundel County, Maryland.

Collections.—Maryland Geological Survey, U. S. National Museum.

Family INCERTAE

Genus PROTOPHYLLOCLADUS Berry

[Bull. Torrey Club, vol. xxx, 1903, p. 440]

PROTOPHYLLOCLADUS SUBINTEGRIFOLIUS (Lesquereux) Berry (?)

Plate LVI, Fig. 2

Phyllocladus subintegrifolius Lesquereux, 1868, Amer. Jour. Sci., vol. xlvi, p. 92.

Phyllocladus subintegrifolius Lesquereux, 1874, Cret. Fl., p. 54, pl. i, fig. 12.

Thinnfeldia lesquereuxiana Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 37, pl. xliv, figs. 9, 10; pl. xlvi, figs. 11, 12a, 12b.

Phyllocladus subintegrifolius Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 34, pl. ii, figs. 1-3.

Thinnfeldia lesquereuxiana Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xi, p. 98, pl. iii, fig. 6.

Thinnfeldia lesquereuxiana Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 59, pl. xi, figs. 1-17.

Thinnfeldia subintegrifolia Knowlton, 1898, Bull. U. S. Geol. Survey, No. 152, p. 228.

Protophyllocladus subintegrifolius Berry, 1903, Bull. Torrey Bot. Club, vol. xxx, p. 440.

Protophyllocladus subintegrifolius Berry, 1904, *Ibidem*, vol. xxxi, p. 69, pl. i, fig. 5.

Protophyllocladus subintegrifolius Berry, 1907, Johns Hopkins Univ. Circ., n. s., No. 7, pp. 89-91, fig. 6.

---

[1] Berry, Bull. Torrey Bot. Club, vol. xxxix, pp. 341-348, pl. xxiv, 1912.

[2] Berry, Md. Geol. Survey, Lower Cretaceous, p. 428, pl. lxxiii, figs. 1-6, 1911.

Protophyllocladus subintegrifolius Hollick, 1907, Mon. U. S. Geol. Survey, vol. 1, p. 36, pl. v, figs. 1-6.

Protophyllocladus subintegrifolius Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 98, pl. ix.

Description.—Leaves oblong to linear in outline and coriaceous in texture, from 3 cm. to 17 cm. in length by 0.6 cm. to 3 cm. in width. Apex usually obtuse, rarely pointed. Base decidedly and narrowlv cuneate to the short petiole. Margins entire below, above obtusely dentate or undulate, with occasionally teeth which are acute. Midrib stout below becoming attenuated above and frequently disappearing some distance below the apex. Laterals numerous, close, immersed; they branch at an angle of about 20°, running nearly straight and approximately parallel to the margin, sometimes forking. Stomata scattered on both surfaces, with typical guard cells.

This is a widespread species ranging in considerable abundance from Greenland (Atane beds) to Alabama (Tuscaloosa formation), and west to Kansas and Nebraska (Dakota sandstone). Originally referred to *Phyllocladus* by Lesquereux, his type is almost identical with certain phylloclads of modern members of this genus. Subsequently discovered remains from Kansas are considerably larger than the type, as are also a number of the Greenland specimens. Some of the Raritan forms have a somewhat different aspect, being long and narrow; sometimes the margins are entire, often they are more or less sharply toothed.

Much controversy has centered around these forms and especially around the older Mesozoic forms referred to the genus *Thinnfeldia* Ettingshausen, to which these later forms were once referred. The latter genus has been referred successively to the conifers, ferns and cycads. There has never been much doubt that the later forms were gymnospermous. The writer can positively affirm this conclusion, and also that they are true phylloclads and not leaves in the strict morphological sense.

Whether or not they are closely related to the modern genus *Phyllocladus* is still in doubt, although there are some excellent arguments for such a relationship. While fossil remains of undoubted relationship to *Phyllocladus* are extremely rare, Gothan has described[1] wood of a similar type

[1] Gothan, Kgl. Svenska Vetens. Akad. Handl., Bd. xlii, No. 10, 1907.

from the Jurassic of the east coast of Greenland under the name of *Phyllocladoxylon*. The present species has not heretofore been recorded in the Coastal Plain south of the New Jersey area, although it is apparently represented by fragmentary material in the Magothy formation of Maryland and the Tuscaloosa formation of Alabama.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

PROTOPHYLLOCLADUS LOBATUS Berry

***Thinnfeldia* sp. nov. Berry, 1907, Johns Hopkins Univ. Circ., n. s., No. 7, p. 81.**

***Protophyllocladus lobatus* Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 403.**

***Protophyllocladus lobatus* Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 17, pl. ii, figs. 9-13.**

Description.—Leaves (phylloclads) of large size, lanceolate or oval in general outline, either entire with crenate margins, rounded apex and narrowly cuneate base or compound through the development of opposite lateral lobes. Axial vascular strand very stout below, becoming very thin and finally disappearing apically. When lobate, subordinate opposite vascular strands form the axis of the lobes, and these are usually but not always lost before reaching the tips of the lobes by giving off innumerable secondary branches. Margins in all cases are rather remotely undulate-crenate and the tips are all rounded. Secondaries numerous and thin, diverging from the main axis of the phylloclad on the axis of the lobes at very acute angles, curving outward, either simple, more often dichotomously forked, and occasionally several times forked. Lobes when present separated by cuneate narrowly rounded sinuses which terminate some distance from the main axis. The largest specimen, which is still incomplete at both the apex and the base, measures 8 cm. in length and 5 cm. from tip to tip of the lower lobes, the upper entire portion measuring about 1.5 cm. in width.

These remains are superficially like fern fronds, especially in specimens that are compound, and were it not for the presence in the Cretaceous of other *Phyllocladus*-like remains with a demonstrated gymnospermous

structure (*e. g., Androvettia*) their reference to this genus would seem hazardous. The entire specimens are strikingly like some of the forms of *Protophyllocladus subintegrifolius* (Lesquereux) Berry of the Magothy formations, or like *Protophyllocladus polymorphus* (Lesquereux) Berry from higher western American horizons, and even the compound specimens have an unlobed apical portion of comparable length which is also similar in appearance to the two species just mentioned. The compound forms are superficially like *Thinnfeldia rhomboidalis* Ettingshausen,[1] the type of the genus *Thinnfeldia,* whose systematic position has been the occasion of so much controversy and which has been variously regarded as a fern, a cycad, or a conifer. The present species shows important differences, however, aside from its much younger age, and it is confidently believed to be unrelated to the various older Mesozoic species of *Thinnfeldia* that have been described.

It may also be compared with various forms from the Upper Cretaceous of Dalmatia which were discussed at great length by Kerner,[2] who refers them to the genus *Pachypteris.* This he regards as cycadaceous in nature, but it is believed to be closest to *Protophyllocladus subintegrifolius,* a species which is abundant in the Atane beds of Greenland, the Dakota group of Kansas and Nebraska, the Raritan of New Jersey, and the Magothy from Marthas Vineyard to New Jersey, and which often assumes a sublobate form. This is especially shown in unreported collections made by the writer in the Magothy formation of New Jersey.

The present species is present in the Magothy formation and frequent in the Middendorf beds of South Carolina. The latter occurrences will be fully described and illustrated in a forthcoming professional paper of the U. S. Geological Survey.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

[1] Ettings., Abhl. Geol. Reichsanstalt, Bd. iii, p. 2, pl. i, figs. 4-7, 1852.
[2] Kerner, Jahrb. Geol. Reichsanstalt, Bd. xlv, p. 39, 1896.

Genus RARITANIA Hollick and Jeffrey

[Mem. N. Y. Bot. Garden, vol. iii, 1909, p. 26]

RARITANIA GRACILIS (Newb.) Hollick and Jeffrey

Plate LV, Figs. 2, 3

Frenelopsis gracilis Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 59, pl. xii, figs. 1-3a.

Frenelopsis gracilis Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 167.

Raritania gracilis Hollick and Jeffrey, 1909, Mem. N. Y. Bot. Garden, vol. iii, p. 26, pl. vi, figs. 4-7; pl. ix, figs. 1-4; pl. x, figs. 14-17; pl. xix, figs. 3-6; pl. xx, fig. 1.

Raritania gracilis Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 92.

Description.—Twigs of a conifer, represented in the clays by crowded cylindrical branches of graceful aspect and slender forking habit. The leaves are reduced almost to the vanishing point, in fact most specimens fail to show any traces of leaves whatever, and it is possible that these spirally-arranged scale-like leaves of Newberry's description may have been founded upon deceptive material.

These twigs are unjointed, an objection against their former reference to the genus *Frenelopsis*. It has been suggested that they represent decorticated specimens of *Widdringtonites reichii* (Ettingshausen) Heer, which is so common in the Raritan and overlying Magothy formation. The present species is recorded from both Delaware and Maryland.

Hollick and Jeffrey have shown (*loc. cit.*) from anatomical preparations that the present species is not related to *Frenelopsis* or *Widdringtonites*, but constitutes a distinct genus.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

Genus GEINITZIA Endlicher

[Synop. Conif., 1847, p. 280]

GEINITZIA FORMOSA Heer[1]

Plate LIV, Fig. 6

Geinitzia formosa Heer, 1871, Kreidfl. v. Quedlinb. Neue Denks. Schw. Gesell., Bd. xxiv, No. 2, p. 6, pl. i, fig. 9; pl. ii.

Geinitzia sp. Newberry. 1873, Proc. N. Y. Lyc. Nat. Hist., 2d ser., p. 10.

Sequoia reichenbachi Lange, 1890 *(ex parte)*, Zeits. Deutsch. Geol. Gesell., Bd. xlii, p. 770.

Geinitzia formosa Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, 1895, p. 51, pl. ix, fig. 9.

Sequoia gracillima Newberry, 1896, *Ibidem*, pl. ix, figs. 1-3 (non foliage description on p. 50).

Geinitzia formosa Hollick, 1897, Trans. N. Y. Acad. Sci., vol. xvi, p. 129, pl. xii, figs. 1, 2.

Sequoia reichenbachi ? Stanton and Knowlton, 1897, Bull. Geol. Soc. Amer., vol. viii, p. 137.

Geinitzia formosa Knowlton, 1900, Bull. U. S. Geol. Survey, No. 163, p. 28, pl. v, figs. 1, 2.

Geinitzia formosa Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 57.

Sequoia gracillima Berry, 1903, *Ibidem*, pl. xlviii, figs. 21, 22.

Sequoia gracillima Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 69, pl. ii.

Geinitzia formosa Berry, 1904, *Ibidem*, p. 68, pl. iv, figs. 2, 3.

Sequoia gracillima Berry, 1904, Amer. Geol., vol. xxxiv, pl. 15.

Sequoia gracillima Berry, 1905, Bull. Torrey Bot. Club, vol. xxxii, p. 44.

Sequoia gracillima Berry, 1906, *Ibidem*, vol. xxxiii, p. 165.

Sequoia gracillima Berry, 1906, Rept. State Geol of New Jersey for 1905, p. 139.

Geinitzia formosa Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 97.

Geinitzia gracillima Jeffrey, 1911, Bot. Gazette, vol. l, pp. 21-27, pl. viii.

Description.—" Strobile ovato-cylindrici, squamis rachi validæ spiraliter insertis, apice peltatis, disco concavo, margine crenato, toroso; semina sub quavis squama quatuor (?), squamarum stipite crasso inserta, striata.

[1] This species is said to be represented by *Carpolithes hemlocinus* of Schlotheim. See also a work by Ernst von Otto entitled, " Additamente zur Flora des Quadergebirges in der Gegend um Dresden und Dippoldiswalde," etc., pt. 1, pl. v, figs. 1-3, 5, 6, 1852.

This species probably includes the cones from the Raritan of Woodbridge, New Jersey, identified by Newberry as *Microzamia gibba* (Reuss) Corda, Mon. U. S. Geol. Survey, vol. xxvi, p. 45, pl. xii, figs. 6, 7, 1896. Berry, Bull. 3, Geol. Survey of New Jersey, p. 78, 1911.

Ramulis elongatis, virgatis, foliis omnino tectis, foliis subfalcatis, angustis, apice valde attenuatis, uninerviis, ramis adultis pulvinis rhombeis obtectis."—Heer, 1871.

The American occurrences of cones of this species have heretofore been referred to *Sequoia gracillima* Newberry, a composite made up of *Geinitzia* cones and *Widdringtonites* foliage. These cones are exceedingly abundant in the Magothy formation at Cliffwood Bluff, New Jersey, where those that are more or less pyritized are washed out of the clays by storms and high tides. When preserved as flattened lignitic inclusions they are somewhat different in appearance, and it is believed that material of this species in the latter condition of preservation is the basis for the Raritan forms which were identified as *Microzamia gibba* Corda by Newberry.[1] A single cone is contained in the Magothy collections made along the Chesapeake and Delaware Canal.

The foliage, which resembles somewhat that of *Sequoia reichenbachi* (Geinitz) Heer, as well as that of *Cunninghamites squamosus* Heer, shows rather thick twigs with slender curved needle leaves interspersed with small scale-like leaves. It has been found at a number of localities in this country and is represented in the Tuscaloosa formation of Alabama by several doubtful specimens.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

Genus MORICONIA Debey and Ettingshausen
[Denks. Wienakad., Bd. xvii, 1859, p. 239]

MORICONIA AMERICANA Berry
Plate LVI, Fig. 1

Moriconia cyclotoxon Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 65, pl. xliii, fig. 4; pl. xlviii, figs. 1-4 (non Debey and Ettingshausen).

Moriconia cyclotoxon Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 70.

Moriconia cyclotoxon Berry, 1906, *Ibidem*, vol. xxxiii, pp. 165-167.

Moriconia americana Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, pp. 20, 186.

Moriconia americana Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 26, pl. vii, figs. 1-4.

[1] Newberry, Mon. U. S. Geol. Survey, vol. xxvi, p. 45, pl. xii, figs. 6, 7, 1896.

Description.—Leafy twigs, apparently deciduous in habit, bifacial, phylloclad-like, consisting of cyclically-arranged leaves. Along the main axis on each flat face of the branch these leaves are relatively and closely appressed, with a narrow base and a broad semicircular apex. The corresponding lateral pairs of leaves are thin and pointed and transversely compressed. In the axis of each of these marginal leaves is a reduced branch flattened in the same plane as the main branch, so that the whole arrangement is strictly opposite and distichous. These reduced lateral branches have leaves of the same character and arrangement as those of the main branch. The bifacial leaves are, however, somewhat smaller and blunter and the marginal leaves are broader and less acute. They become rapidly smaller distad, it usually requiring not more than five or six pairs to complete the blunt lateral reduced twigs. The main vascular arrangement is strictly opposite and distichous. These reduced lateral branches. The leaves fail to show any veins. The texture was apparently coriaceous but obviously thin in the majority of specimens. No structural material or indications of fruits or fruiting characters have been discovered. This species, formerly confused with *Moriconia cyclotoxon* of Debey and Ettingshausen, differs from the latter, which is the type and only other known species of the genus, in being more phylloclad-like and strictly comparable to a cupressineous genus like *Libocedrus*. It is also much larger (about 100 per cent) than the type of the genus, the lateral twigs are more reduced and the main axis is invariably leafy. It differs also in its geological range, the two species not being anywhere contemporaneous in America, although the type in Europe extends as high as the later larger form of America.

Superficially these remains closely resemble fragments of fern fronds; in fact, Debey, the original discoverer, always insisted that they were ferns, and Heer described the earliest collected and poorly preserved remains from Greenland as a species of *Pecopteris*. There can be no doubt, however, of their gymnospermous nature. For stratigraphic purposes they are one of the most characteristic fossil plants known, since the geometrically arranged outline of the leaves is recognizable with certainty in the smallest fragment.

They are strikingly like the curious genus *Androvettia* recently described by Hollick and Jeffrey[1] and which these authors refer to the *Araucarieæ,* although *Moriconia* has, on the evidence of the foliage characters, been invariably referred to the *Cupressineæ.* The present species is common in the Middendorf beds of South Carolina, and is a characteristic post-Raritan species in the Atlantic Coastal Plain, having been recorded by the writer from numerous localities in the Magothy formation of the northern Coastal Plain, and from the Black Creek formation in North Carolina.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Round Bay, Anne Arundel County, Maryland.

Collection.—Maryland Geological Survey.

Genus CZEKANOWSKIA Heer
[Fl. Foss. Arct., Bd. iv, Ab. ii, 1876, p. 65]

CZEKANOWSKIA CAPILLARIS Newberry

***Czekanowskia capillaris* Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, 1895, p. 61, pl. ix, figs. 14-16.**

***Czekanowskia capillaris* Hollick and Jeffrey, 1909, Mem. N. Y. Bot. Garden, vol. iii, p. 63, pl. vi, figs. 1-3.**

***Czekanowskia capillaris* Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 101.**

Description.—Leaves deciduous, linear or capillary, striated, long and slender, undivided (?) or dichotomously forked. Length 8 cm. to 10 cm.

These remains occur as closely packed masses, irregular fascioles and isolated fragments, and when unforked or much broken might readily be mistaken for pine leaves. There are not uncommon in the Raritan of Maryland and are clearly identical with the remains described under the foregoing name from the Middle Raritan of New Jersey and Staten Island. No basal portions showing subtending scale-leaves like those of some of the Jurassic species have been found.

The genus *Czekanowski* was founded by Heer[2] in 1876 with *Czekanowskia setacea* from the Middle Jurassic (Bathonian) of Siberia as the

[1] Hollick and Jeffrey, Mem. N. Y. Bot. Gard., vol. iii, p. 22, pl. iii, figs. 1-5, etc., 1909.

[2] Heer, Beitr. z. Jura-Flora Ostsibiriens und des Amurlandes; Mém. l'Acad. Imp. Sci., St. Pétersb., 7e série, tome xxii, 1876, p. 65; Fl. Foss. Arct., Bd. iv, Ab. ii.

type. He characterized the genus in the following terms: " Folia numerosa in ramulo abbreviato, caduco fasciculata, subulata, rigida, dichotoma, squamis compluribus persistentibus circumdata. Flores feminei racemosi. Fructus pedunclo brevi insidens, nuculis duabus valde approximatis."

The genus is discussed at length by Heer, who considers that the associated small seeds represent the same plant which is therefore placed among the *Gymnospermæ* and referred to the *Ginkgoales*. In this reference most later students concur (*vide* Schenk in Zittel, Paläophytologie, p. 267, 1890; Seward, Jurassic Flora, pt. I, p. 276, 1900), although identical remains have constituted the genera *Jeanpaulia* of Unger,[1] *Sclerophyllina* of Heer,[2] and *Solenites* of Lindley and Hutton.[3] These remains in whole or in part have been variously referred to the *Algæ* (Lindley and Hutton), to the *Rhizocarpaceæ* (F. Braun, Unger, Brongniart), to the *Isoetaceæ* (Unger, Brongniart, Zigno, Schimper), and to the *Filicales* proper (Shenk, Schimper, etc.).

The genus *Czekanowskia,* which is intimately related to *Trichopitys* Saporta and *Baiera* F. Braun, is distinguished from both chiefly by the less divided, or undivided, needle-like leaves. It is confined to the northern hemisphere, appearing in the Rhætic of Scandinavia (*C. longissima* Nathorst), and becoming differentiated and widespread in Middle Jurassic times (*C. heerii* Nathorst, *C. setacea* Heer, *C. palmatisecta* Heer, *C. rigida* Heer, and *C. viminea* (Phillips) Berry[4] It is represented in the Lower Cretaceous by *C. dichotoma* Heer of the Arctic regions and *C. nervosa* Heer of western Europe. The latter survives into the Upper Cretaceous, and a single species, *C. capillaris* Newberry, is present in the early Upper Cretaceous of America. All these forms are very much alike megascopically.

The remains are often common but are usually poorly preserved and resemble masses of long slender needle-leaves like those of *Pinus,* and this

[1] Unger, Gen. et Sp., p. 224, 1850.

[2] Heer, Urwelt der Schweiz, p. 55, 1865.

[3] Lindley and Hutton, Foss. Fl. Gt. Britain, vol. ii, pl. cxxi, 1834.

[4] This is the correct name for the form commonly called *C. Murrayana* (L. and H.), since Phillips' name antedates that of Lindley and Hutton by five years.

resemblance is heightened by occasional specimens (Heer) showing the tuft of leaves subtended proximad by a few small scale-leaves, as in the short shoots of *Pinus.* In *Czekanowski,* however, unmistakable dichotomy is frequent, and this habit has been one of the main factors in its reference to the *Ginkgoales* which are so abundant and varied during the Mesozoic.

Occurrence.—RARITAN FORMATION. Forked Creek, Severn River, Anne Arundel County.

Collection.—Johns Hopkins University.

ANGIOSPERMOPHYTA

CLASS MONOCOTYLEDONAE

Genus DORYANTHITES Berry

[Bull. Torrey Bot. Club, vol. xxxviii, 1911, p. 406]

DORYANTHITES CRETACEA Berry

Plate LVI, Fig. 6

Doryanthites cretacea Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 406.

Doryanthites cretacea Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 108, pl. xvii, fig. 3.

Description.—Leaves, as preserved, linear, presumably lanceolate above and sheathing below, 4.5 cm. to 6 cm. in width and preserved without any diminution in width for a length of 50 cm. Texture very coriaceous. Margins entire. Veins simple and parallel, immersed, considerably less than 1 mm. apart. Leaves alike on both surfaces. In the hollows between the veins occur rows of small stomata with the guard cells all oriented in a direction parallel with the veins and equally numerous on both surfaces of the leaf. Leaf surfaces under the microscope appearing finely striated parallel with the veins.

These curious remains, which call to mind the leaves of the Paleozoic *Cordaites* or some modern giant Bromeliad, are not uncommon in the Upper Cretaceous. They were first discovered by the writer in the Black Creek formation of North Carolina, and it is from this material that the

stomatal characters are described. Recently this same form was discovered in considerable abundance at the Georgia locality near Buena Vista, Marion County, in the Eutaw formation of Hale County, Alabama, and in the Magothy formation of Maryland.

Referring to similarly appearing remains previously described, it may be noted that Miquel[1] in 1853 described under the heading *Phyllites monocotylei* two sorts of parallel-veined leaf-fragments from the Upper Cretaceous of Aachen (Rhenish Prussia). The first (pl. i, fig. 3) he calls *Yuccites (?)*, and the second, which suggests the fossils under discussion, is designated "*Palma* vel *Yuccites (?)*." From the Valanginian of Portugal Heer[2] described what he calls *Bambusium latifolium*, which is also suggestive of the American material. Krasser[3] described somewhat similarly appearing remains from the Cretaceous (Cenomanian ?) of Moravia as *Typhæloipum cretaceum*. These are somewhat smaller than the American forms and show transverse veinlets which are absent in the latter. Saporta[4] referred forms of this kind, which are not uncommon in the Cenomanian of Portugal, to a new monocotyledonous genus, which he calls *Phyllotænia*, comparing it with *Bambusa, Rhizocaulon*, etc. Smaller but otherwise comparable Lower and Upper Cretaceous forms were named by Schenk[5] *Eolirion*, and similar older Mesozoic forms are commonly referred to the form-genus *Yuccites*.[6] Perhaps the most similar fossils known are those referred to the genus *Krannera*, and fully described by Velenovsky,[7] who does not, however, arrive at any satisfactory conclusion regarding their relationship, although he thinks they are Cycadaceous.

It seems undesirable to refer the present material to *Yuccites*, since while it is similar to the more ancient remains so named, it is entirely improbable that it is congeneric with the Triassic type upon which this

[1] Miquel, Verh. geol. kaart. Nederl. I, 1853, pp. 33-56, plates i-vii.

[2] Heer, Cont. Fl. Foss. Portugal, 1881, p. 22, pl. 19, figs. 1-3.

[3] Krasser, Beitr. z. Kennt. Foss. Kreidefl. v. Kunstadt, 1896, p. 15, pl. ii, fig. 4.

[4] Saporta, Fl. Foss. Port., 1894, pp. 216, 221, pl. xxxviii, figs. 6-8, 12, 13, 21; pl. xxxix, fig. 20.

[5] Schenk, Pal., Bd. xix, 1869, p. 20.

[6] Schimper and Mougeot, Mon. Pl. Foss. Vosges, 1844, p. 42.

[7] Velenovsky, Gym. Böhm. Kreidefl., 1885, p. 1.

genus was founded, and such an identification would consequently be very misleading. Until the existing tropical *Monocotyledonæ* are more abundantly represented in our larger herbaria, or more complete and decisive Cretaceous material is discovered, the botanical affinity of these anomalous forms must remain undetermined. The name chosen indicates superficial resemblance and does not imply actual relationship with the modern genus *Doryanthes* of the order *Liliales.*

Little reliance can be placed upon a similarity of appearance in dealing with fragmentary remains of this sort, and the foregoing are mentioned merely as indicating the presence of undetermined *Monocotyledonæ* of large size in the Cretaceous floras of the world.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collections.—Maryland Geological Survey, U. S. National Museum.

Order POALES

Family CYPERACEAE

Genus CAREX Linné

[Sp. Pl., 1753, p. 972]

CAREX CLARKII Berry

Carex clarkii Berry, 1905, Amer. Nat., vol. xxxix, pp. 3-7, fig. 1.
Carex clarkii Berry, 1906, Ann. Rept. State Geol. of New Jersey for 1905, pp. 138-141.
Carex clarkii Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 169.
Carex clarkii Berry, 1907, Johns Hopkins Univ. Circ., n. s. No. 7, p. 81.
Carex clarkii Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 29.

Description.—Leaf fragments up to 6 cm. in length, varying in width from 1.5 mm. to 4 mm., averaging between 2 mm. and 3 mm., slightly keeled, becoming thicker and narrower proximad; midrib moderately prominent. Lateral veins, which are parallel with it, very fine and scarcely discernible except in the larger specimens.

In common with other fossil remains of grasses and sedges this species has no botanical value, except as an indication of the presence of plants of this type in the Cretaceous; it has, however, like so many fossils of vague

botanical affinities, considerable stratigraphic value, since it is found to characterize the Magothy formation at a large number of outcrops from New Jersey to Maryland. It occurs also in the Middendorf beds of South Carolina.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

Order ARALES

Family ARACEAE

Genus PISTIA Linné

[Sp. Pl., 1753, p. 963]

PISTIA NORDENSKIOLDI (Heer) Berry

Plate LVI, Fig. 3

Chondrophyllum nordenskioldi Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 114, pl. xxx, fig. 4b; pl. xxxii, figs. 11, 12.

Chondrophyllum nordenskioldi Berry, 1907, Bull. Torrey Bot. Club, vol. xxxiv, p. 198, pl. xiii, fig. 1.

Pistia nordenskioldi Berry, 1910, *Ibidem*, vol. xxxvii, p. 189, pl. xxi, figs. 1-15.

Pistia nordenskioldi Berry, 1911, *Ibidem*, vol. xxxviii, p. 405.

Description.—" P. foliis ovalibus, integerrimis, basi attenuatis, nervis primordialibus quinque, duobus lateralibus basi connatis."—Heer, 1874.

This species, based on a few incomplete specimens from the Atane beds of Greenland, was described by Heer in 1874. Thirty-three years later the writer identified it in a small collection from the Cretaceous of North Carolina. In 1907 and 1908 it was found to be exceedingly abundant in the Black Creek formation of North Carolina, and this abundant material has enabled the writer to settle its botanical position and to somewhat amplify Heer's diagnosis.

The leaves are elliptical or orbicular in outline, with a broadly rounded or slightly truncated apex and a decurrent base, which is broad and flat for a distance of about 1 cm. Total length of leaf varying from 3 cm. to 6 cm., averaging about 4.5 cm. Maximum width ranging from 2 cm. to

4 cm., averaging about 3 cm. Margins entire, slightly irregular. Texture coriaceous. A wide false midrib in the basal part of some of the leaves is formed by the convergence of the digitate veins which are thin and diverge at acute angles in a flabellate manner and pursue a relatively straight upward course, inosculating in the marginal regions. They send off frequent pseudo-dichotomous inosculating branches. An ultimate areolation of thin transverse veins forms an open four or five-sided mesh. The epidermis is preserved in some instances. The stomata are few and scattered and are confined to one surface and are altogether absent from the broad leaf-bases.

In its size, outline, and venation this species is scarcely to be distinguished from the modern *Pistia stratiotes* Linné, which is certainly a variable and widely distributed, chiefly tropical, species. In this country it is found from Florida to Texas. Elsewhere it occurs in the West Indies and southward through Mexico and Central America to Paraguay and Argentina. In Africa it is found from Natal to Senegambia and Nubia, occurring also in Madagascar and the Mascarene Islands. In Asia it occurs throughout the East Indies and northward to the Philippines.

The fossil forms are more like the younger leaves of the modern plant (possibly a phylogenetic character in the latter), the later leaves tending toward a cuneate outline with a truncated apex and straighter sides.

But few fossils have been referred to this genus. Hosius and von der Marck described in 1880 what they called *Pistites loriformis* from the Lower Senonian of Westphalia (Pal., Bd. xxvi, p. 182, pl. xxxviii, figs. 151, 152), but this is probably cycadean, as Schenk suggested (in Zittel's Handbuch, p. 378, 1890). Lesquereux in 1876 (Ann. Rept. U. S. Geol. and Geog. Survey, Terr., p. 299, 1874) named a remarkably well-preserved form from Point of Rocks, Wyoming, *Pistia corrugata*. This was fully described and illustrated in his Tertiary Flora (p. 103, pl. lxi, figs. 1, 3-7, 9-11, 1883) and included leaves of various sizes, and rootlets. It comes from beds belonging to the Montana formation (Senonian), which are of about the same age as the French beds from which the only other Cretaceous species is known. This latter, *Pistia mazelii,* was mentioned

and figured from the lignites of Fuveau (Provence), France, by Saporta and Marion in their popular work, *L'Evolution du Règne Végétal,* published in 1885 (Phanérogames, tome ii, p. 37, figs. 114c, 114d), but has never been adequately described.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

Order ARECALES

Family ARECACEAE

Genus SABALITES Saporta

[Études, tome ii, 1865, p. 77]

SABALITES MAGOTHIENSIS (Berry) Berry

Plate LVI, Figs. 4, 5

Flabellaria magothiensis Berry, 1905, Torreya, vol. v, tf. 1, 2.

Flabellaria magothiensis Berry, 1906, Ann. Rept. State Geol. of New Jersey for 1905, pp. 139-141.

Flabellaria magothiensis Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 170.

Flabellaria magothiensis Berry, 1910, *Ibidem*, vol. xxxvii, p. 21.

Sabalites magothiensis Berry, 1911, *Ibidem*, vol. xxxviii, p. 405.

Description.—Based on fragmentary remains of a large, palmetto-like fan-palm. Rays numerous, broad, coriaceous, longitudinally striated by thin veins, the stouter veins occurring at intervals of from 2 mm. to 4 mm.

Remains of these large flabellate palm leaves are very common at several localities in the Magothy formation from Raritan Bay in New Jersey to the Severn River in Maryland. They are invariably much broken, so that they baffle precise description or determination. They are of great interest, however, as being among the earliest known occurrences of undoubted palms. They are associated in New Jersey with petrified palm wood (*Palmoxylon cliffwoodensis* Berry).

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Round Bay, Anne Arundel County, Maryland.

Collections.—Maryland Geological Survey, U. S. National Museum.

CLASS DICOTYLEDONAE

Order MYRICALES

Family MYRICACEAE

Genus MYRICA Linné

[Sp. Pl., 1753, p. 1024]

MYRICA LONGA (Heer) Heer

Plate LVII, Figs. 1-3

Proteoides longus Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 110, pl. xxix, fig. 8b; pl. xxxi, figs. 4, 5.

Proteoides longus Dawson, 1883, Trans. Roy. Soc. Canada, vol. i, sec. iv, p. 22, pl. ii, fig. 8.

Myrica longa Heer, 1883, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 65, pl. xviii, fig. 9b; pl. xxix, figs. 15-17; pl. xxxiii, fig. 10; pl. xli, fig. 4d.

Myrica longa Heer, 1883, *Ibidem*, Bd. vii, p. 21.

Myrica longa Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 67, pl. iii, figs. 1-6.

Myrica longa Bartsch, 1896, Bull. Lab. Nat. Hist., Iowa Univ., vol. iii, p. 180.

Myrica longa Knowlton, 1901, 21st Ann. Rept. U. S. Geol. Survey, pt. vii, p. 314, pl. xxxix, fig. 7.

Myrica longa Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 170.

Description.—Leaves of various sizes, linear to lanceolate in outline, with a stout midrib, numerous thin, ascending, camptodrome secondaries, entire margins, obtusely pointed apex, narrowly decurrent base and long stout petiole.

This species was described by Heer as a *Proteoides* and subsequently referred to the genus *Myrica*. It occurs in both the Atane and Patoot beds of Greenland, in the Dakota sandstones of the West, in the Magothy formation of Maryland, in the Woodbine formation of Texas, and is very common in the Tuscaloosa formation of Alabama. Abroad it has been recorded [1] from the lower Turonian of Bohemia.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County; Bodkin Point, Round Bay, Little Round Bay, Anne Arundel County.

Collections.—Maryland Geological Survey, U. S. National Museum.

[1] Frič, Archiv. Naturw. Landes Böhm., Bd. iv, No. 1, 1878, pp. 18, 94.

Order SALICALES

Family SALICACEAE

Genus SALIX Linné

[Sp. Pl., 1753, p. 1015]

SALIX FLEXUOSA Newberry

Plate LVII, Fig. 4

Salix flexuosa Newberry, 1868, Later Ext. Floras, p. 21.
Salix flexuosa Newberry, 1878, Ill. Cret. and Tert. Plants, pl. i, fig. 4.
Salix proteæfolia linearifolia Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 49, pl. xliv, figs. 1-3.
Salix proteæfolia flexuosa Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 50, pl. xliv, figs. 4, 5.
Salix protæfolia flexuosa Hollick, 1894, Bull. Torrey Bot. Club, vol. xxi, p. 50, pl. clxxiv, fig. 5.
Salix proteæfolia flexuosa Hollick, 1898, Ann. N. Y. Acad. Sci., vol. xi, p. 59, pl. iv, fig. 5a.
Salix proteæfolia flexuosa Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 67, pl. xlviii, fig. 12; pl. li, fig. 2.
Salix flexuosa Berry, 1906, Ann. Rept. State Geol. Survey of New Jersey for 1905, p. 145.
Salix flexuosa Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 171.
Salix proteæfolia linearifolia Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 52, pl. viii, fig. 12.
Salix proteæfolia flexuosa Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 51, pl. viii, figs. 5, 6a; pl. xxxvii, fig. 8b.
Salix flexuosa Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 115.
Salix flexuosa Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, pp. 32, 109, pl. vii, figs. 14-16; pl. xi, fig. 1.

Description.—Leaves narrow, linear-lanceolate in outline, equally pointed at both ends, short petioled, ranging from 5 cm. to 10 cm. in length, and from 8 mm. to 13 mm. in maximum width. Margins entire. Midrib stout below, tapering above, often somewhat flexuous. Secondaries more or less remote, about ten alternate pairs, branching from the midrib at angles varying from 35° to 45°, camptodrome, of fine caliber, often obsolete.

This species was described by Newberry from the Dakota group in 1868. Lesquereux subsequently made it one of the varieties of his *Salix proteæfolia,* although it is obviously entitled to independent specific rank. It is of rare occurrence in the Raritan formation of New Jersey, where it

is first found in the uppermost beds at South Amboy, New Jersey, and it is pre-eminently a species which characterizes the Magothy formation from New Jersey to Maryland, and homotaxial horizons to the southward. It is recorded in beds of Magothy age from Marthas Vineyard to the Potomac River. It occurs in the Black Creek beds of North and South Carolina, and in the Middendorf member in the latter state. In Georgia, while not especially abundant, characteristic leaves of this species are found from the base to the top of the lower Eutaw formation in the western part of the state. In Alabama it is very common at a relatively large number of localities from the base to the top of the Tuscaloosa formation.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Sullivan's Cove, Anne Arundel County, Maryland.

Collection.—Maryland Geological Survey.

SALIX LESQUEREUXII Berry

Plate LVII, Figs. 5-8

Salix proteæfolia Lesquereux, 1874, Cret. Fl., p. 60, pl. v, figs. 1-4.
Salix proteæfolia Lesquereux, 1883, Cret. and Tert. Fl., p. 42, pl. i, figs. 14-16; pl. xvi, fig. 3.
Salix proteæfolia Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 49.
Salix proteæfolia longifolia Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 50, pl. xliv, fig. 9.
Proteoides daphnogeoides Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 72 (pars), pl. xxxii, fig. 11.
Dewalquea greenlandica Newberry, 1896, *Ibidem*, p. 129 (pars), pl. xli, fig. 12.
Salix proteæfolia Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 66, pl. xviii, figs. 3, 4.
Salix proteæfolia Lesquereux, 1898, Amer. Jour. Sci., vol. xlvi, p. 94 (non Forbes).
Salix proteæfolia Berry, 1900, Ann. Rept. State Geol. Survey of New Jersey for 1905, p. 139.
Salix proteæfolia Kurtz, 1902, Revista Mus. La Plata, vol. x, p. 51.
Salix proteæfolia Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 171, pl. vii, fig. 2.
Salix proteæfolia Berry, 1907, Johns Hopkins Univ., n. s. No. 7, p. 81.
Salix proteæfolia Berry, 1909, Bull. Torrey Bot. Club, vol. xxxvi, p. 252.
Salix lesquereuxii Berry, 1910, *Ibidem*, vol. xxxvii, p. 21.

Salix lesquereuxii Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 114.
Salix lesquereuxii Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, pp. 33, 109, pl. vii, figs. 11-13.

Description.—Leaves ovate-lanceolate in outline, somewhat more acuminate above than below, variable in size, ranging from 6 cm. to 12 cm. in length, and from 1.1 cm. to 2.2 cm. in greatest width, which is usually slightly below the middle. Petiole stout, much larger than in *Salix flexuosa,* ranging up to 1.2 cm. in length. Midrib stout below, tapering above. Secondaries numerous, sometimes as many as twenty pairs; they branch from the midrib at angles of about 45° and are parallel and camptodrome.

This is an exceedingly variable species, as might be expected in a *Salix,* and Lesquereux established several varieties of which at least one, *i. e., linearifolia,* is referable to *Salix flexuosa* Newberry. Some of Lesquereux's forms are distinguishable with difficulty from the latter, and this is especially shown in the leaves which he figures on plate I of his Cretaceous and Tertiary Flora. They are, however, larger and somewhat more robust, of a thicker texture, and broadest near the base, from which they taper upward to an exceedingly acuminate tip. In general, *Salix lesquereuxii* is a relatively much broader, more ovate form with more numerous and better seen secondaries and a longer petiole.

This species is an exceedingly abundant Cretaceous type in both the East and the West, ranging in the Coastal Plain from the base of the Raritan formation to the top of the Tuscaloosa formation, and possibly through the Eutaw formation as well. It is abundant in the Magothy, Black Creek, and Middendorf beds. In the West it is common in the Dakota sandstone. It is one of the forms recorded by Kurtz from the Upper Cretaceous of Argentina, indicating, if the identification is correct, a very considerable migration during the early Upper Cretaceous. In Alabama it ranges from the bottom to the top of the Tuscaloosa formation.

Occurrence.—RARITAN FORMATION. East Washington Heights, District of Columbia. MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

Genus POPULUS Linné
[Sp. Pl., 1753, p. 1034]

POPULUS STYGIA Heer
Plate LVIII, Fig. 1

Populus stygia Heer, 1873, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 107.
Populus stygia Heer, 1882, *Ibidem*, Bd. vi, Ab. ii, p. 64, pl. xvii, fig. 5; pl. xviii, figs. 5-8; pl. xxxix, fig. 5.
Populus stygia Heer, 1883, *Ibidem*, Bd. vii, p. 30, pl. lv, fig. 6; pl. lxiv, fig. 10.
Populus stygia Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 44, pl. iii, fig. 12.
Populus stygia Hollick, 1907, *Ibidem*, vol. l, p. 49, pl. vii, fig. 30.

Description.—" P. foliis cordatis, integerrimis, nervo primario valido, nervis secundariis ramosis, basilaribus 5, infimis margine approximatis." —Heer, 1873.

This species is variable in size with a subcoriaceous texture, entire margins, cordate base and obtuse tip, with a strongly defined venation. It occurs in both the Atane and Patoot beds of west Greenland, the Dakota sandstone of Kansas, and the Magothy formation of Marthas Vineyard. It is represented in Maryland by very fragmentary material at Bodkin Point, but rather more characteristic although scanty material from Sullivan's Cove on Round Bay, which is certainly identical with the Dakota Sandstone leaves which Lesquereux referred to this species.

Occurrence.—MAGOTHY FORMATION. Bodkin Point, Sullivan's Cove, Anne Arundel County.

Collection.—U. S. National Museum.

Order FAGALES

Family FAGACEAE

Genus QUERCUS Linné
[Sp. Pl., 1753, p. 994]

QUERCUS MORRISONIANA Lesquereux
Plate LVIII, Fig. 2

Quercus morrisoniana Lesquereux, 1883, Cret. and Tert. Flora, p. 40, pl. xvii, figs. 1, 2.
Quercus morrisoniana Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 55.

Quercus morrisoniana Hollick, 1897, Trans. N. Y. Acad. Sci., vol. xvi, p. 131, pl. xiii, figs. 11, 12.

Quercus morrisoniana Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 72.

Quercus morrisoniana Hollick, 1904, *Ibidem*, p. 411, pl. lxxiii, fig. 5.

Quercus morrisoniana Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 56, pl. viii, fig. 4.

Quercus morrisoniana Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 21.

Description.—"Leaves of medium size, coriaceous, petiolate, ovate-lanceolate, acuminate; medial nerve strong; secondary nerves numerous, alternate, curved in passing to the borders, camptodrome, simple, or some of them forking near the borders."—Lesquereux, 1883.

The present species was described from the Dakota group of Colorado and has been subsequently recognized in the Magothy formation of Long Island, New Jersey, and Maryland. There can be no question of the identity of the eastern forms with those of the West, but their relation to the genus *Quercus* is entirely problematical.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

QUERCUS SEVERNENSIS Berry

Plate LVII, Fig. 9

Quercus severnensis Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 22, pl. viii, fig. 3.

Description.—Leaves of small size, ovate-lanceolate in outline, becoming gradually narrowed apically, 7 cm. in length by 2.3 cm. in greatest width, which is in the basal half of the leaf. Apex pointed. Base rounded. Petiole short and stout. Margin entire for its basal fourth, above which it is beset with distant, prominent, serrate teeth separated by inequilateral rounded sinuses. Midrib stout. Secondaries remote, six to eight pairs, subopposite to alternate, branching from the midrib at angles of from 45° to 50°, but slightly curved, not prominent: basal ones sending branches into the teeth, distal ones running direct to the marginal teeth.

This species is somewhat suggestive of the much older *Quercophyllum chinkapinensis* Ward of the Patapsco formation, and it is closely related to

Quercus holmesii Lesquereux of the Dakota group of the West and the Magothy formation of New Jersey. Among modern oaks analogies may be found among the scrub and live oaks of the Pacific Slope, as, for example, *Quercus wislizeni, Q. tomentella,* and *Q. chrysolepsis,* especially the first; and with *Q. ilex* of Europe.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—U. S. National Museum.

Order URTICALES

Family MORACEAE

Genus FICUS Linné

[Sp. Pl., 1753, p. 1059]

FICUS DAPHNOGENOIDES (Heer) Berry

Plate LVIII, Fig. 3

Proteoides daphnogenoides Heer, 1866, Phyll. Cret. d. Nebr., p. 17, pl. iv, figs. 9, 10.

Proteoides daphnogenoides Lesquereux, 1874, Cret. Fl., p. 85, pl. xv, figs. 1, 2.

Proteoides daphnogenoides Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 90.

Proteoides daphnogenoides Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xi, p. 98, pl. iii, figs. 1, 2.

Ficus proteoides Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 77, pl. xii, fig. 2.

Proteoides daphnogenoides Hollick, 1893, *Ibidem*, vol. xii, p. 36, pl. ii, figs. 4, 9, 13.

Proteoides daphnogenoides Hollick, 1894, Bull. Torrey Bot. Club, vol. xxi, p. 52; pl. clxxvii, fig. 1.

Proteoides daphnogenoides Smith, 1894, Geol. Coastal Plain Ala., p. 348 (determined by Ward).

Proteoides daphnogenoides Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 72, pl. xvii, figs. 8, 9; pl. xxxii, figs. 11, 13, 14; pl. xxxiii, fig. 3; pl. xli, fig. 15.

Eucalyptus ? attenuata Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, pl. xvi, fig. 5 (non figs. 2, 3).

Proteoides daphnogenoides Berry, 1903, Bull, N. Y. Bot. Garden, vol. iii, p. 74, pl. li, figs. 6-9.

Ficus daphnogenoides Berry, 1905, Bull. Torrey Bot. Club, vol. xxxii, p. 327, pl. xxi.

Ficus daphnogenoides Berry, 1906, *Ibidem*, vol. xxxiii, p. 173, pl. vii, fig. 5.

Ficus daphnogenoides Berry, 1907, *Ibidem*, vol. xxxiv, p. 194, pl. xi, figs. 10, 11.

Proteoides daphnogenoides Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 59, pl. xii, figs. 1-5.

Ficus daphnogenoides Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 122, pl. xii, fig. 4.

Ficus daphnogenoides Berry, 1912, Bull. Torrey Bot. Club, vol. xxxix, p. 394.

Description.—" Les feuilles sont coriacés, à la base atténuées, entières; la nervure médiane est forte; elle porte deux nervures secondaires faibles, acrodromes, qui sont presque parallèles au limbe; mais elles ne sont pas opposées, comme chez les Daphnagène et Cinnamomum."—Heer, 1866.

This species was described by Heer from the Dakota group of Nebraska, and was based upon very incomplete material. His specimens have some long ascending secondaries, but Lesquereux's more complete specimens from the same horizon and region show that these secondaries were not acrodrome but camptodrome. The species in this feature, and also in other respects, differs from *Protea* and its allies which are more coriaceous, with the secondaries branching at acute angles and massed toward the often apetiolate base. On comparison with the genus *Ficus* it is found to closely resemble a number of different species from such widely separated localities as Central and South America and the Celebes. Especially among the Mexican and Central American forms are very similar leaves seen, *e. g.*, *Ficus fasciculata* Watson, *Ficus lancifolia* Hooker and Arnott, *Ficus ligustrina* Kunth and Bouche, and *Ficus sapida* Miquel, especially the latter, which has much the same outline and consistency, the same prominent midrib, and the same venation. Placed in the genus *Ficus*, where these fossil forms properly belong, they find their affinity in the group which includes, among others, such species as *Ficus elongata* Hosius, *Ficus berthoudi* Lesquereux, *Ficus suspecta* Velenovsky, *Ficus krausiana* Heer, etc.

This species has been found to be quite variable in size, ranging in length from 11 cm. to 22 cm. and in width from 1.9 cm. to 3.7 cm. It is usually widest in the lower half of the leaf, although sometimes the base is quite narrow and the widest part is toward the middle. In all unequivocal

material the upper half of the leaf is narrow and is produced as a long, slender, often recurved tip, which is one of the characteristic features of the species. This tip is strictly comparable with the "dripping points" developed on various leaves in the modern tropics where precipitation is heavy.

Ficus daphnogenoides is a widespread and common form ranging from Marthas Vineyard to Texas in eastern North America, and from Northwest Territory to Kansas and Nebraska in the Western Interior.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

FICUS OVATIFOLIA Berry

Plate LIX, Fig. 4

Ficus ovata Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 70, pl. xxiv, figs. 1-3 (non Don 1803).

Ficus woolsoni Berry, 1907, Bull. Torrey Bot. Club, vol. xxxiv, p. 194, pl. xii, fig. 1.

Ficus ovatifolia Berry, 1909, Bull. Torrey Bot. Club, vol. xxxvi, p. 253.

Ficus ovatifolia Berry, 1911, *Ibidem*, vol. xxxviii, p. 410.

Ficus ovatifolia Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 123, pl. xii, fig. 3.

Ficus ovatifolia Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 111, pl. xix, figs. 5-7.

Description.—Leaves ovate in outline, 8 cm. to 13 cm. in length by 4 cm. in width, petiolate. Apex extended, acute. Base rounded or somewhat descending. Margins entire. Principal veins three, from the base, the midrib being the stoutest and slightly flexuous. The lateral veins diverge at angles of about 45° and curve upward, traversing somewhat more than the basal half of the leaf and connecting with branches from the lowest pair of camptodrome secondaries, of which there are several alternating pairs branching from the midrib at wider angles. The laterals give off on the outside eight to ten camptodrome veins. Quadrangular areoles formed by nearly straight transverse nervilles fill all the intervening space.

This species is very close to *Ficus woolsoni* Newberry, which is a much less elongated comparatively broader leaf, often with a cordate base in consequence.

Occurrence.—RARITAN FORMATION. East Washington Heights, District of Columbia.

Collection.—Maryland Geological Survey.

FICUS CECILENSIS n. sp.

Plate LVIII, Fig. 4

Description.—Leaves of medium size, broad-lanceolate in general outline, with a narrowed but bluntly pointed tip and a somewhat more gradually narrowed, pointed base. Length about 13 cm. Maximum width, in the middle part of the leaf, about 3.75 cm. Margins entire. Texture subcoriaceous. Petiole very stout, its length unknown. Midrib very stout and prominent. Secondaries thin, about seven alternate pairs; they diverge from the midrib at irregular intervals at angles of about 40°, curving upward, camptodrome. Tertiaries thin, well marked, at approximately right angles to the midrib, forming large, quadrangular, usually transversely elongated, areoles.

The generic reference of this new form is not certainly determined, as it partakes of the features of lauraceous, ericaceous, and rhamnaceous leaves as well as those of the extensive genus *Ficus*. It is readily distinguishable from the species of the latter with which it is associated.

Occurrence.—MAGOTHY FORMATION. Grove Point Cecil County

Collection.—U. S. National Museum.

FICUS CRASSIPES (Heer) Heer

Plate LVIII, Fig. 5; Plate LIX, Figs. 2, 3

Proteoides crassipes Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 110, pl. xxxi, figs. 6-8a.

Ficus crassipes Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 70, pl. xvii, fig. 9a; pl. xxiv, figs. 1, 2.

Ficus crassipes Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 79, pl. xiii, fig. 3.

Ficus crassipes Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 172.
Ficus daphnogenoides Berry, 1907, Johns Hopkins Univ. Circ., n. s. No. 7, p. 81.
Ficus crassipes Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, pp. 37, 110, pl. x, fig. 4; pl. xii, figs. 8-10.

Description.—Leaves entire, narrowly lanceolate in outline, about equally tapering to the acuminate apex and base. Length 12 cm. to 20 cm. Greatest width, which is in the middle part of the leaf, 1.8 cm. to 2.5 cm. Texture coriaceous. Midrib stout, often extraordinarily so. Secondaries thin, open, ascending, camptodrome.

This species was described originally from the Atane beds of Western Greenland, the first rather fragmentary specimens collected suggested a relationship with the genus *Proteoides.* Subsequently the original describer referred it to *Ficus,* where it undoubtedly belongs. Lesquereux has recorded it from the Dakota group and it is common in the Magothy formation of the northern Atlantic Coastal Plain and in the Black Creek formation of North Carolina. It persists into the Eutaw formation of Georgia and is especially common in the Middendorf beds of South Carolina. It is not especially common in the Tuscaloosa formation, and is a species which is especially characteristic of the post-Raritan and pre-Montana horizons of eastern North America.

The leaf substance is partially preserved in part of the Alabama material and shows in microscopic preparations the spiral tracheids of the leaf veins and numerous lactiferous cells. Both lower and upper epidermal layers are well preserved. They are thin and highly cuticularized, the epidermis consisting of very small, nearly equilateral, quadrangular, thick-walled cells. The stomata are few and scattered and are confined to the lower surface. They consist of two rather thin, sausage-shaped guard cells set on edge (*i. e.,* much higher than wide), the length equal to two epidermal cells.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Little Round Bay, Anne Arundel County, Maryland.

Collection.—Maryland Geological Survey.

FICUS KRAUSIANA Heer

Plate LIX, Fig. 1

Ficus krausiana Heer, 1869, Neue Denks, Schw. Ges., Bd. xxiii, p. 15, pl. v, figs. 3-6.
Ficus krausiana Fric, 1878, Archiv. Naturw. Landes, Böhm., Bd. iv, No. 1, pp. 18, 94.
Ficus beckwithii Lesquereux, 1883, Cret. and Tert. Fl., p. 46, pl. xvi, figs. 5; pl. xvii, figs. 3, 4.
? *Ficus suspecta* Velenovsky, 1885, Fl. Böhm, Kreidef., Theil iv, p. 10, pl. v, figs. 6, 9.
Ficus atavina Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xi, p. 103, pl. iv, figs. 4, 6 (non Heer).
Ficus krausiana Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 81, pl. i, fig. 5.
Ficus krausiana Hollick, 1895, Bull. Geo. Soc. Amer., vol. vii, p. 13.
Ficus krausiana Hollick, 1898, Ann. N. Y. Acad. Sci., vol. xi, p. 59, pl. iii, fig. 1.
Ficus krausiana Frič and Bayer, 1901, Archiv. Naturw. Landes Böhm., Bd. xi, No. 2, p. 117.
Ficus krausiana Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 58, pl. ix, fig. 9; pl. x, figs. 1-3.
Ficus krausiana Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 172.
Ficus krausiana Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, pp. 38, 110, pl. xi, figs. 4-7; pl. xix, fig. 4.

Description.—Leaves of large size, ovate-lanceolate in outline, broadest at or below the middle. Apex and base acutely pointed, the apex often extended and attenuated. Petiole and midrib stout. Secondaries regular, open, thin, ascending, camptodrome, branching from the midrib at angles of 45° or more. Length about 17 cm. Greatest width about 4 cm.

This well known Upper Cretaceous species was described originally from the Cenomanian of Moravia, and it has been subsequently recorded from both the Cenomanian and Turonian of Bohemia. It occurs at a large number of American localities. In the West it occurs in the Dakota sandstone, while in the East it is common from Marthas Vineyard to Alabama, and is present between these limits in Maryland, North Carolina, South Carolina, and Georgia. These occurrences are all in beds of Magothy age or younger. In both North and South Carolina *Ficus* fruits are associated with this species, but whether they are to be referred to it or to some of the other rather numerous species of *Ficus* which

occur at the same localities cannot be determined. The present species is one of the commonest post-Raritan and pre-Montana fossils in the Coastal Plain, and it is especially abundant in the Middendorf formation of South Carolina. In Alabama it is not uncommon in the Tuscaloosa formation and it persists into the basal Eutaw beds in Hale County.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

Order PLATANALES

Family PLATANACEAE

Genus PLATANUS Linné

[Sp. Pl., 1753, p. 999]

PLATANUS HEERII Lesquereux

Plates LXV, LXVI, LXVII

Platanus heerii Lesquereux, 1872, Ann. Rept. U. S. Geol. Survey, Terr. (Hayden) for 1871, p. 303 (non Ward).

Sassafras recurvatus Lesquereux, 1873, Ann. Rept. U. S. Geol. Survey, Terr. (Hayden) for 1872, p. 424 (non Heer 1882).

Platanus heerii Lesquereux, 1874, Cret. Fl., p. 70, pl. viii, fig. 4; pl. ix, figs. 1, 2.

Platanus recurvata Lesquereux, 1874, Cret. Fl., p. 71, pl. x, figs. 4, 5 (non fig. 3).

? *Platanus heerii* Lesquereux, 1878, Rept. on Clays in New Jersey, p. 29.

Platanus heerii Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 72, pl. vii, figs. 1, 2; pl. viii, figs. 1, 2a; pl. ix, figs. 1-4.

? *Platanus heerii* Lesquereux, 1883, Cret. and Tert. Fl., p. 44, pl. iii, fig. 1; pl. vii, fig. 5.

Sassafras (Araliopsis) recurvatum Lesquereux, 1883, Cret. and Tert. Fl., p. 57 (pars).

Sassafras cretaceum recurvatum Berry, 1902, Bot. Gazette, vol. xxxiv, p. 438.

Platanus heerii Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 23.

Platanus heerii Berry, 1911, *Ibidem*, vol. xxxviii, p. 411.

Description.—Leaves broadly rhomboidal in outline, more or less trilobate. Lobes, when developed, short and obtuse. Base decurrent. Petiole long and stout. Margin sublobate, undulate or irregularly dentate. Texture coriaceous. Primaries three, stout, diverging at acute angles. The lateral primaries are as stout as the midrib from which they branch

in an opposite or subopposite position, either from the extreme base or a considerable distance above the base. In the latter case there is often a prominent secondary given off from the midrib on either side below the primaries. The primaries may give off a few rather long, straight, craspedodrome secondaries to the rather full lateral margin, or they may send off a stout lateral branch at varying distances above the base. Secondaries from the midrib few in number, stout, irregularly spaced, craspedodrome. Tertiaries transverse, platanoid.

This species was described from the Dakota sandstone of Kansas by Professor Lesquereux in 1872, who subsequently in his Cretaceous Flora confused it with *Platanus* or *Sassafras recurvatum*. The latter, if it really designates a species, must be restricted to the form figured by Lesquereux on pl. x, fig. 3 of the Cretaceous Flora, which is decidedly different from his other figures on that plate. The latter are leaves of *Platanus heerii*, while the former must be referred to *Sassafras cretaceum* or *mirabile*. Not only is it distinctly trilobate but the margin is entire and the venation camptodrome, while in the leaves of *Platanus heerii* on the same plate the form and margin are different and the venation is craspedodrome. Professor Heer correctly identified *Platanus heerii* from the Atane beds of Greenland, and the forms which he figured from these beds as *Sassafras recurvatum* are distinct from *Platanus heerii* and resemble Lesquereux's fig. 3 mentioned above. The writer some years ago (1902, *loc. cit.*) in discussing *Sassafras recurvatum* pointed out the composite nature of this form and suggested that those forms which are here referred to *Platanus heerii* were referable to *Platanus*, while the other type was comparable with *Sassafras cretaceum* or *mirabile*.

Professor Ward in 1887[1] after sending figures of some leaves which he had collected at Black Buttes, Wyoming (a probably basal Eocene locality) to Lesquereux, who insisted that they were not *Platanus heerii*, persisted in identifying them as this species, although they are obviously not closely related to it.

[1] Ward, Bull. U. S. Geol. Survey, No. 37, 1887, p. 34, pl. xv, figs. 3, 4.

Platanus heerii was identified by Lesquereux from the New Jersey Raritan in collections made from Pettit's pits, South River, but as the material was poor and the species has not since been detected in the New Jersey Raritan this occurrence is usually ignored, although the abundance of this species in the Raritan of Maryland renders its presence in New Jersey probable. Fragments of this species in the Maryland Raritan are very common, but they are usually in a bad state of preservation. The species extends northward to the west coast of Greenland and it shows considerable resemblance to *Credneria rhomboidea* described by Velenovsky from the Cenomanian of Bohemia,[1] and subsequently transferred by him to *Platanus*.

Occurrence.—RARITAN FORMATION. Drum Point Railroad near head of Severn River, Anne Arundel County, Maryland; East Washington Heights, District of Columbia.

Collections.—Maryland Geological Survey, U. S. National Museum.

Genus ASPIDIOPHYLLUM Lesquereux

[Ann. Rept. U. S. Geol. Survey Terr. (Hayden) for 1874, p. 361, 1876]

ASPIDIOPHYLLUM TRILOBATUM Lesquereux

Plate LX, Figs. 1, 2; Plate LXI, Figs. 1, 2

Aspidiophyllum trilobatum Lesquereux, 1876, Ann. Rept. U. S. Geol. Survey, Terr. (Hayden) for 1874, p. 361, pl. ii, figs. 1, 2.

Aspidiophyllum trilobatum Lesquereux, 1883, Cret. and Tert. Fl., p. 87, pl. xii, fig. 1; pl. xiii, figs. 1-5; pl. xiv, fig. 1.

Aspidiophyllum trilobatum Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 212.

Aspidiophyllum trilobatum Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 410.

Description.—Medium to large sized leaves, rhomboidal in general outline, obtusely trilobate. Length 10 cm. to 25 cm. Maximum width, which is across the lobes in the basal half of the leaf, 10 cm. to 30 cm. Base truncate or broadly cuneate, markedly peltate. Lobes broad and rounded. Sinuses open and rounded, extending less than half-way to the

[1] Velenovsky, Fl. Böhm. Kreidef., Theil i, 1882, p. 11, pl. iii, figs. 2, 3; pl. iv, fig. 1.

base. Petiole and midrib very stout. Lateral primaries stout but somewhat less so than the midrib, opposite, curved, diverging from the midrib at an angle of about 45°, or more rather than less, inserted some distance (about 1 cm.) above the peltate base. Secondaries numerous, rather strong, approximately parallel, diverging from the primaries at angles of about 45° or more, camptodrome. Tertiaries well marked, transverse, of a style common to *Ficus, Platanus, Sassafras,* etc. Margin entire, somewhat undulate or sublobate in some specimens. Texture coriaceous. The basal peltate shield varies from broadly rounded to suborbicular and in some specimens it is sublobate with a craspedodrome downwardly directed secondary running to the tip of each lobule. Where it is simply rounded the secondaries are all camptodrome.

This species was described by Professor Lesquereux in 1874 and was based upon material from the Dakota sandstone of Kansas, to which horizon the genus has been hitherto confined. This species is, however, not uncommon in the Raritan deposits of Maryland where it is associated with representatives of the genus *Protophyllum,* another peculiar Dakota sandstone series of forms. The material is unfortunately rather poorly preserved, having been much macerated before fossilization, but it is complete enough, as is shown by the specimens figured, for certainly in identification.

The genus *Aspidiophyllum,* in which three species have been described has never had its botanical affinity satisfactorily determined, although it is probably related to *Protophyllum.* Professor Lesquereux fancied that it was related to his Dakota species of *Sassafras* (*Araliopsis*), and he also pointed out its resemblance to some of the European forms referred to Zenker's genus *Credneria.* Professor Ward was disposed to regard it as related to *Platanus,* and certainly the species *Aspidiophyllum dentatum* Lesquereux is very close to those species of *Platanus,* which, like *Platanus basilobata* Ward or *Platanus appendiculata* Lesquereux, have a peltate basilar shield, a condition exhibited as an atavistic character in occasional leaves of the modern *Platanus occidentalis* Linné. Schenk was disposed to consider *Aspidiophyllum* as a member of the family

Urticaceæ. It must be confessed, however, that the data are still lacking from which to settle the question.

Occurrence.—RARITAN FORMATION. Shannon Hill, Cecil County; Forked Creek, Severn River, Anne Arundel County, Maryland; East Washington Heights, District of Columbia.

Collections.—Maryland Geological Survey, U. S. National Museum.

Genus PROTOPHYLLUM Lesquereux
[Cret. Fl., 1874, p. 100]

PROTOPHYLLUM STERNBERGII Lesquereux

Plate LXII, Figs. 1-3; Plate LXIII, Figs. 1, 2; Plate LXIV, Fig. 3

Pterospermites sternbergii Lesquereux, 1873, Ann. Rept. U. S. Geol. Survey, Terr. (Hayden), for 1872, p. 425.
Protophyllum sternbergii Lesquereux, 1874, Cret. Fl., p. 101, pl. xvi; pl. xviii, fig. 2.
Protophyllum sternbergii Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 189, pl. xlii, fig. 1.
Protophyllum sternbergii Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 411.

Description.—Leaves of large size, ranging from 13 cm. to 25 cm. in length by from 10 cm. to 20 cm. in maximum width, which is at a point below the middle; broadly oval in outline, with an obtusely pointed apex and a cordate or slightly subpeltate base. Margins entire, somewhat undulate. Midrib stout. Secondaries stout, about ten or eleven subopposite to alternate pairs, the lower pairs branching from the midrib at a wide angle which becomes acute in the upper pairs. The secondaries are all craspedodrome and send off one or two strong craspedodrome branches. Tertiaries fine, transverse. Texture coriaceous.

This species, which has not hitherto been found outside of the Dakota sandstone, from which horizon it was described as a species of *Pterospermites* by Professor Lesquereux as early as 1872, is not uncommon in the Raritan deposits of Maryland. The specimens, partly because of the large size of the leaves, are rather fragmentary, some of the more complete fragments being figured. There can be no question of their identity with the western forms of *Protophyllum,* although the true systematic position

of the genus remains unsettled. There is considerable resemblance to Lesquereux's genus *Aspidiophyllum* and also to the European forms referred to Zenker's genus *Credneria*, both of which are genera of undetermined botanical affinity. Lesquereux referred a number of Dakota group species to this genus, which may possibly be regarded as a synthetic type.

Occurrence.—RARITAN FORMATLON. Shannon Hill and Bull Mountain, Cecil County, Maryland; East Washington Heights, District of Columbia.

Collections.—Maryland Geological Survey, U. S. National Museum, N. Y. Botanical Garden.

PROTOPHYLLUM MULTINERVE Lesquereux

Plate LXIII, Fig. 3; Plate LXIV, Figs. 1, 2

Pterospermites multinervis Lesquereux, 1872, Ann. Rept. U. S. Geol. Survey, Terr. (Hayden) for 1871, p. 302.
Protophyllum multinerve Lesquereux, 1874, Cret. Fl., p. 105, pl. xviii, fig. 1.
Protophyllum multinerve Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 191, pl. xliii, fig. 2; pl. lxv, fig. 1.
Protophyllum multinerve Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 411.

Description.—Leaf of medium size, averaging considerably smaller than the preceding species and more nearly orbicular in outline, 9 cm. to 15 cm. in length by 9 cm. to 13 cm. in maximum width, which is about midway between the apex and the base. Apex rounded or obtusely pointed. Base rounded truncate, subpeltate. Margin entire or regularly undulate, usually constricted at the end of each secondary and branch of a secondary, with usually two slight, rounded undulations between adjacent constrictions. Midrib stout, becoming thin above. Secondaries relatively thin, numerous, craspedodrome, sending off from one to three craspedodrome branches. Tertiaries very numerous, thin, mostly transverse. Texture coriaceous.

This species has hitherto been known only from the Dakota sandstone of southern Kansas, from which area it was described by Professor Lesquereux in 1871. It is rather common in the Raritan clays at Cedar Point,

but the remains are very fragmentary, some of the larger fragments being those figured. They clearly represent a species of *Protophyllum* distinct from the preceding species and are identical with *Protophyllum multinerve* in their observed characters, especially in the peculiar margin.

Occurrence.—RARITAN FORMATION. Cedar Point, Baltimore County, Maryland; East Washington Heights, District of Columbia.

Collection.—Maryland Geological Survey.

Order POLYGONALES

Family POLYGONACEAE

Genus COCCOLOBITES n. gen.

COCCOLOBITES CRETACEUS n. sp.

Plate LXVIII, Fig. 1

Description.—Leaves of large size, elliptical in general outline, with a broadly rounded, slightly emarginate tip, and a broadly cuneate base. Length about 9 cm. Maximum width, near the middle of the leaf, about 6 cm. Margins entire, more or less prominently undulate, inequilateral, occasionally approaching sublobate in the prominence of some of the undulations. Petiole short and stout, or wanting. Midrib stout. Secondaries stout, about seven camptodrome pairs. Tertiaries prominent, forming open polygonal meshes.

This species is obviously new, although it resembles somewhat the Raritan leaf described by Newberry [1] as *Phyllites undulatus,* which differs principally in its finer venation.

The resemblance to the leaves of the Eocene and existing species of *Coccolobis* has suggested the proposal of a new genus allied to and possibly ancestral to the latter. *Coccolobis* has about one hundred and twenty species in the existing flora, many of which are coastal forms, and all confined to the American tropics.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

[1] Newberry, Mon. U. S. Geol. Survey, vol. xxvi, p. 131, pl. xxiv, fig. 10, 1896.

Order RANALES

Family MAGNOLIACEAE

Genus MAGNOLIA Linné

[Sp. Pl., 1753, p. 535]

MAGNOLIA HOLLICKI Berry

Plate LXIX, Fig. 3

Dicotyledonous leaf impression Hitchcock, 1841, Geol. Mass., vol. ii, p. 430, pl. xix, fig. 1.

Magnolia auriculata Hollick, 1894, Bull. Torrey Bot. Club, vol. xxi, p. 61, pl. clxxix, figs. 6, 7 (non Lamarck, 1783).

Magnolia auriculata Smith, 1894, Geol. Coastal Plain Ala., p. 348.

Magnolia auriculata Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 75, pl. lviii, figs. 1-9, 11 (non fig. 10).

Magnolia auriculata Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 174.

Magnolia auriculata Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 67, pl. xix, fig. 5; pl. xx, figs. 5, 8.

Magnolia hollicki Berry, 1909, Bull. Torrey Bot. Club, vol. xxxvi, p. 253.

Magnolia hollicki Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 136, pl. xv, fig. 3.

Description.—Leaves orbicular-ovate in outline, 4 cm. to 10 cm. in length by 2 cm. to 5.5 cm. in width, petiolate. Apex acute, slightly extended in one or two specimens. Base usually pronounced auriculate. Petiole and midrib stout. Secondaries few, six or seven pairs, subopposite, camptodrome. Texture smooth and subcoriaceous.

This fine species is abundant and well preserved at Woodbridge in the New Jersey Raritan and in the Magothy formation of Maryland and Marthas Vineyard. Professor Newberry was somewhat uncertain as to its relationship with *Magnolia* and compared it with *Aristolochia, Polygonum,* and *Toxylon.* The latter is the only genus which is at all suggestive, and it furnishes no instances of auriculate bases, while this character of the base prevails in more than one modern species of *Magnolia.* The outline, the consistency, and the venation are all in accord in pointing to *Magnolia* as the proper generic reference. This is one of those forms mentioned from Marthas Vineyard by Professor Hitchcock in his *Geology of Massachusetts,* published in 1841.

It is sparsely represented in the Tuscaloosa formation of Alabama, and has been confused with *Magnolia speciosa* by both Newberry and Ward.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

MAGNOLIA LACOEANA Lesquereux

Plate LXX, Figs. 1, 2

Magnolia lacoeana **Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 201, pl. lx, fig. 1.**
Magnolia lacoeana **Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 73, pl. lv, figs. 1, 2.**
Magnolia lacoeana **Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 65, pl. xvii, fig. 2.**
Magnolia lacoeana **Berry, 1910, Bull. Torrey, Bot. Club, vol. xxxvii, p. 23.**
Magnolia lacoeana **Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 134, pl. xvi, fig. 2.**

Description.—Leaves broadly oval to almost orbicular in outline, obtuse or abruptly pointed above and rounded to a somewhat cuneate base below, 10 cm. to 12 cm. in length by 8.5 cm. to 9.5 cm. in maximum width. Midrib stout, somewhat flexuous. Secondaries numerous, camptodrome medianly stout, ten to twelve pairs; they branch from the midrib at acute angles, immediately curving outward, forming festoons near the margin, which is somewhat undulate in one specimen which Professor Newberry referred to this species.

This species differs from its contemporaries, especially in its nearly round outline; Professor Lesquereux finds a resemblance to *Magnolia inglefieldi* Heer from Greenland, and it also suggests some of the Arctic forms which have been referred to *Magnolia capellinii* Heer.

While this species is reported from such widely separated points as Marthas Vineyard and Kansas, it is nowhere abundant and is usually poorly preserved, suggesting that the leaves were readily macerated. In Alabama it appears to be confined to the lower Tuscaloosa.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—U. S. National Museum.

MAGNOLIA LONGIPES Hollick

Plate LXIX, Fig. 2

Magnolia longipes Hollick, 1894, Bull. Torrey Bot. Club, vol. xxi, p. 60, pl. clxxviii, fig. 3.

Magnolia alternans Ward, 1894 in Smith, Geol. Coastal Plain Ala., p. 348 (non Heer).

Magnolia longipes Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 76, pl. liv, figs. 1 3.

Magnolia longipes ? Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 64, pl. xxi, figs. 5, 6.

Magnolia longipes Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 23.

Magnolia longipes Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 135, pl. xiv, fig. 1.

Description.—Leaves oblong-ovate in outline, apparently about 18 cm. in length by 6 cm. or 7 cm. in maximum width, which was below the middle. Apex obtusely rounded. Base usually cuneate. Midrib and petiole very stout, the latter unusually long, reaching 12 cm. or 13 cm. in some specimens. Secondaries camptodrome, relatively thin and remote, ten to twelve pairs, branching from the midrib at angles of about 45° and soon curving upward to join a branch from the secondary next above. This forms a series of large arches which approximately parallel the margin, and constitutes one of the distinctive characters of this species, others being the long petiole and the oblong, almost straight-sided, shape.

This is a very striking *Magnolia* and is frequent in the middle Raritan at Woodbridge, New Jersey. Fragmentary specimens which have been correlated with these remains are reported from Long Island. It is apparently quite different in appearance from any of the other Cretaceous species of *Magnolia,* although it suggests somewhat a gigantic form of *Magnolia woodbridgensis.* It is found in the Magothy formation of Maryland and the Tuscaloosa formation of Alabama. In the absence of complete specimens, only the basal part being usually preserved, it is quite possible that the present specimens are not distinct from some of the associated Magnolias.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—U. S. National Museum.

MAGNOLIA OBTUSATA Heer

Plate LXVIII, Figs. 2-4

Magnolia capellinii Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, pl. xxxiii, fig. 4.
Magnolia obtusata Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 90, pl. xv, fig. 12, pl. xxi, fig. 3.
Magnolia obtusata Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 201, pl. lx, figs. 5, 6.
Magnolia obtusata Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 76, pl. xlvii, fig. 4.
Magnolia obtusata Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 23.

Description.—Leaves of variable size, oblong-ovate or obovate in outline, entire, with a broadly rounded apex and a narrowed cuneate base, ranging from 7 cm. to 14 cm. in length, and 2.4 cm. to 7 cm. in greatest width, which is above the middle. Petiole and midrib stout. Secondaries few in number ascending, curved, camptodrome. Texture coriaceous.

This species was described from the Atane beds of Greenland by Heer, and was based upon rather fragmentary material. Subsequently Lesquereux recorded some fine specimens from the Dakota group of Kansas. It is present in the Magothy formation from New Jersey to Maryland, and in beds of homotaxial age in South Carolina. In western Alabama it appears to be confined to the lower Tuscaloosa of Fayette County.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collections.—Maryland Geological Survey, U. S. National Museum.

MAGNOLIA BOULAYANA Lesquereux

Plate LXIX, Fig. 1

Magnolia boulayana Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 202, pl. lx, fig. 2.
Magnolia glaucoides Hollick, 1894, Bull. Torrey Bot. Club, vol. xxi, p. 60. pl. clxxv, figs. 1, 7.
Magnolia glaucoides Smith, 1894, Geol. Coastal Plain in Alabama, p. 348.
Magnolia glaucoides Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 74, pl. lvii, figs. 1-4.
Magnolia boulayana Knowlton, 1901, Twenty-first Ann. Rept. U. S. Geol. Survey, pt. vii, p. 318.
Magnolia glaucoides Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, fig. 6, p. 67, pl. xix, fig. 6; pl. xx, fig. 6.

Magnolia boulayana Berry, 1909, Bull. Torrey Bot. Club, vol. xxxvi, p. 254.
Magnolia boulayana Berry, 1910, *Ibidem*, vol. xxxvii, p. 23.
Magnolia boulayana Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 112, pl. xx, fig. 5.

Description.—Leaves narrowly elliptical in outline, unusually uniform in size and shape, 8.5 cm. to 13 cm. in length and 3.5 cm. to 4.5 cm. in maximum width. Apex usually bluntly rounded, sometimes acute. Base matching the apex. Petiole mediumly stout, 3 cm. to 4 cm. in length. Midrib mediumly stout. Secondaries slender, often obsolete, about eleven pairs, equidistant, parallel, camptodrome, branching from the midrib at an angle of about 40°. Tertiaries, when seen, transverse. Texture coriaceous.

This species was described originally from the Dakota group of Kansas by Professor Lesquereux. Professor Newberry described the Raritan remains which are abundant at the Woodbridge locality as a new species, and it has been kept distinct by Hollick, who recognized, however, its practical identity with the Dakota group plant. There can be no question that they belong to the same species, and it seems probable that *Magnolia van ingeni* described by Hollick[1] should also be referred to the same species.

In addition to the localities already mentioned this species is found on Marthas Vineyard and Long Island, in the Eutaw formation of western Georgia, and in the Woodbine formation of the western Gulf region (Texas). Characteristic specimens of this species are present in the lower Tuscaloosa beds of Alabama.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County; Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

MAGNOLIA TENUIFOLIA Lesquereux

Plate LXX, Fig. 2

Magnolia tenuifolia Lesquereux, 1868, Amer. Jour. Sci., vol. xlvi, p. 100.
Magnolia tenuifolia Lesquereux, 1874, Cret. Flora, p. 92, pl. xxi, fig. 1.
Magnolia tenuifolia Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 198, pl. xxiv, fig. 1.

[1] Hollick, Bull. Torrey Bot. Club, vol. xxi, 1894, p. 61, pl. clxxv, fig. 6.

Magnolia tenuifolia Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 77, pl. xlvii, fig. 10.

Magnolia tenuifolia Berry, 1904, Torrey Bot. Club, vol. xxxi, p. 76, pl. i, fig. 7.

Magnolia tenuifolia Hollick, 1904, Bull. N. Y. Bot. Garden, vol. iii, p. 413, pl. lxxiii, fig. 2.

Magnolia tenuifolia Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 174.

Magnolia tenuifolia Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 64, pl. xvii, fig. 1; pl. xviii, figs. 4, 5.

Description.—"Leaves large, oblong, entire, narrowed upward to a blunt point, downward to a thick petiole; median nerve thick; secondaries open, parallel, alternate, inequidistant, forking at a distance from the borders, camptodrome; the lower gradually shorter, at right angles to the median nerve and like tertiaries, curving backward."—Lesquereux, 1892.

This species is widely distributed in the Dakota sandstone of the West. Along the Atlantic border it is represented in post-Raritan deposits by fragmentary and not positively identified material from Marthas Vineyard, through Long Island, New Jersey, and Delaware to the Maryland border.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

MAGNOLIA CAPELLINII Heer

Plate LXIX, Fig. 4

Magnolia capellinii Heer, 1863, Phyll. Crét. d. Nebr., p. 21, pl. iii, figs. 5, 6.

Magnolia capellinii Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 115, pl. xxxiii, figs. 1-4.

Magnolia capellinii Heer, 1882, *Ibidem*, Bd. vi, Ab. ii, p. 90, pl. xxiv, figs. 3-5; pl. xxv, figs. 1-3; pl. xlv, fig. 1.

Magnolia capellinii Velenovsky, 1883, Fl. Böhm. Kreidef., Theil ii, p. 20, pl. vii, figs. 8, 9.

Magnolia capellinii Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 203, pl. lxvi, fig. 1.

Magnolia capellinii Dawson, 1894, Trans. Roy. Soc. Canada, 1st ser., vol. xi, sec. iv, p. 63, pl. xi, fig. 49; pl. xiii, fig. 49a.

Magnolia capellinii Hollick, 1895, Trans. N. Y. Acad. Sci., vol. xii, p. 234, pl. vi, fig. 6.

Magnolia capellinii Hollick, 1895, Bull. Geol. Soc. Amer., vol. vii, p. 13.

Magnolia capellinii Frič and Bayer, 1901, Archiv. Naturw. Landes. Böhm., Bd. xi, Nr. ii, p. 127.

Magnolia capellinii Hollick, 1904, Bull. N. Y. Bot. Garden, vol. iii, p. 413, pl. lxxviii, fig. 3.

Magnolia capellinii Berry, 1904, Bull. Torrey Club, vol. xxxi, p. 76, pl. iii, fig. 3.

Magnolia capellinii Berry, 1906, Ann. Rept. State Geol. of New Jersey for 1905, p. 138.

Magnolia capellinii Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 63, pl. xvii, figs. 3, 4.

Magnolia capellinii Berry, 1907, Bull. Torrey Bot. Club, vol. xxxiv, p. 195, pl. xii, figs. 4, 5.

Magnolia capellinii Berry, 1911, *Ibidem*, vol. xxxviii, p. 406.

Magnolia capellinii Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, pp. 43, 112, pl. xx, fig. 6.

Description.—"M. foliis coriaceis, late ovalibus, integerrimis, nervis secundariis angulo acuto egredientibus, curvatis, camptodromis."—Heer, 1866.

These leaves vary considerably in size, averaging about 13 cm. in length by 7 cm. in width. Outline broadly ovate, the base and apex usually about equally pointed, although occasional specimens have a somewhat obtuse apex. The texture is coriaceous or subcoriaceous. Midrib and petiole stout. Secondaries usually seven or eight alternate or subopposite pairs at regular intervals, approximately parallel, camptodrome.

This widespread species in some of its forms approaches quite close to the less narrow and less apically extended forms of *Magnolia speciosa* Heer. Ordinarily, however, the latter species may be readily distinguished by its relatively narrower form with the produced apex and decurrent base.

Described originally from the Dakota sandstone by Heer, *Magnolia Capellinii* has been detected at a large number of localities of homotaxial age, occurring in the Cretaceous of Greenland and of the Pacific Coast, and in the Cenomanian of Bohemia. In the Atlantic Coastal Plain it characterizes the Magothy formation and is present in the Black Creek beds of North Carolina, the basal Eutaw of Georgia, and the Tuscaloosa formation of Alabama. It was doubtfully recorded from the New Jersey Raritan by Lesquereux in 1878, but it has never been detected in the abundant collections of Raritan plants studied by Professor Newberry and the writer and is not at present admitted to be a member of the Raritan flora.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County; Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Genus ILLICIUM Linné
[Syst., ed. x, 1759, p. 1050]

ILLICIUM DELETOIDES n. sp.

Plate LXX, Fig. 6

Description.—Leaves of relatively small size, lanceolate in general outline, with an acuminate apex and a narrowly decurrent base. Length about 9 cm. Maximum width, in the middle part of the leaf, about 1.5 cm. to 2 cm. Margins entire, but usually more or less undulate. Texture coriaceous. Petiole not preserved. Midrib stout, prominent, more or less flexuous. Secondaries about ten subopposite to alternate pairs, diverging from the midrib at wide angles (about 65°), pursuing relatively straight courses two-thirds of the distance to the margins, where they turn upward to form wide ascending camptodrome arches.

This species may be compared with a variety of described species in unrelated genera, as, for example, in the genera *Nyssa, Daphne, Apocynum, Andromeda,* and various *Lauraceæ;* but it is believed to have more in common with *Illicium,* in which only two other Cretaceous species are known. These are *Illicium deletum* Velenovsky [1] from the Cenomanian of Bohemia and *Illicium watereensis* Berry [2] from the Middendorf beds of South Carolina. The present species differs from the latter in its less numerous and less ascending secondaries. It is very close to the Bohemian species, which fact has suggested the specific name of this form. It is a more slender leaf with fewer secondaries, and would, but for its wide geographical separation, probably be considered to be merely a variant of the Bohemian type.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—U. S. National Museum.

[1] Velenovsky, Fl. Böhm. Kreideform., Theil iii, 1884, p. 4, pl. iii, fig. 5.

[2] Berry, E. W., Prof. Paper U. S. Geol. Survey, No. 84, p. 44, pl. xiv, fig. 8, 1914.

Genus CARPITES Schimper

[Pal. Végét., tome iii, 1874, p. 421]

CARPITES LIRIOPHYLLI Lesquereux

Plate LXX, Figs. 4, 5

Carpites liriophylli Lesquereux, 1883, Cret. and Tert. Fl., p. 77, pl. xi, fig. 5.
Carpites liriophylli Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 174.

Description.—A ligneous winged seed or carpel, ovate in general outline, flattened, curved somewhat toward the thickened proximal end which also shows a vertical scar of attachment about 3 mm. in length. Surface somewhat striated, 2.5 cm. to 3 cm. in length, 6 mm. to 7 mm. in maximum width midway between the ends; distal end more narrowed than proximal, acuminate; proximal end obtuse.

This species was described by Lesquereux from the Dakota group and based on a single specimen found in association with the problematical genus *Liriophyllum*. It reappears in the Magothy in more typical form and appears to be definitely related to the genus *Liriodendron*.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

Family NYMPHAEACEAE

enus NELUMBITES Berry

[Maryland Geol. Survey, Lower Cret., 1911, p. 462]

The genus *Nelumbites* was proposed by the writer in 1911 for ancestral forms related to the modern genus *Nelumbo,* with *Menispermites virginiensis* Fontaine[1] from the Patapsco formation of Maryland and Virginia as the type. One additional Patapsco species, *Nelumbites tenuinervis* (Fontaine) Berry, was described. Additional species include the following Magothy form and probably the large-leafed *Nelumbo kempii* Hollick[2] from the same formation in New Jersey and on Long Island and Marthas Vineyard. Small-leafed forms also occur at higher horizons in the Montana group and in the Laramie and Shoshone group of the West.

[1] Fontaine, Mon. U. S. Geol. Survey, vol. xv, 1890, p. 321, pl. clxi, figs. 1, 2.
[2] Hollick, Mon. U. S. Geol. Survey, vol. l, 1907, p. 61, pl. xiii, figs. 1-4; pl. xiv, figs. 1, 2; pl. xv; pl. xvi, figs. 1-6.

Still other and mostly larger species are referred to the allied genus *Nelumbium* of Jussieu.

While the Patapsco species have the characteristic peltate leaves they are not radially symmetrical as are the later species, but have the petiole attached near to one margin giving them an appearance much like that of a number of supposed species of *Menispermites*. The venation is, however, nearer that of *Nelumbo* and its allies, the secondaries being prominent on the lower surface, obsolete on the upper surface, and forking after the manner of the *Nymphæaceæ*. If these leaves were not floating it is surprising that a petiole stout enough to hold the leaf erect is not found fossil, unless the leaf normally abscissed from the apex instead of the base of the petiole. It is hoped that sooner or later specimens will be found showing whether or not the stomata were confined to the upper surface and thus confirming or disproving the assumption here made that they were aquatic in habit. The existing species of *Nelumbo* are two in number, both large aquatic perennials, one North American and the other Asiatic and Australian. It has seemed better to establish a new genus for the reception of these Cretaceous forms, which, while expressing their proper affinities, does not unduly extend our conception of the modern genus.

It is interesting to note in this connection that Saporta[1] has reported two species of *Nelumbium* from the supposed Albian of Portugal, but as these are not fully defined and are also unfigured their relation to the American species is unknown.

NELUMBITES PRIMÆVA (Berry) Berry

Plate LXXV, Fig. 4

Nelumbo primæva Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 75, pl. xliii, fig. 1.
Nelumbo primæva Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 23.

Description.—Leaves of variable size, peltate, orbicular or broadly elliptical in general outline. Diameter ranging from 3 cm. or 4 cm. to about 10 cm. Margins entire, texture subcoriaceous. Primaries eight,

[1] Saporta, Comptes Rendus, tome cxix, 1894, pp. 835-837.

generally straight, prominent on the lower surface of the leaf, forking dichotomously at variable distances from their origin, giving off thin, transverse more or less curved secondaries.

The present species, which is probably a descendant of *Nelumbites virginiensis,* was described originally from Cliffwood Bluff, New Jersey. It is only known from imperfect materials, but is much smaller and more delicate than *Nelumbo kempii* Hollick (*op. cit.*). It is much like *Nelumbo laramiensis* Hollick,[1] which has, however, twelve primaries. Other comparable species are *Nelumbo intermedia* Knowlton[2] with twelve or thirteen weak primaries, and *Nelumbo dawsoni* Hollick[3] with eighteen primaries.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Order ROSALES

Family LEGUMINOSAE

Genus LUGUMINOSITES Bowerbank

[Foss. Fr. and Seeds London Clay, 1840, p. 124]

LEGUMINOSITES CORONILLOIDES Heer

Plate LXXVI, Fig. 4

Leguminosites coronilloides Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 119, pl. xxxiv, fig. 14.

Colutea coronilloides Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 100.

Leguminosites coronilloides Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 149, pl. xiii, fig. 10.

Leguminosites frigidus Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xii, p. 34, pl. ii, figs. 11.

Leguminosites coronilloides Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 97, pl. xlii, fig. 48.

Leguminosites coronilloides Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 86, pl. xxxii, figs. 16, 17.

Leguminosites coronilloides Berry, 1911, Bull. Torrey Bot. Club, vol. xxxvii, p. 24.

Leguminosites coronilloides Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 153.

---

[1] Hollick, Bull. Torrey Bot. Club, vol. xxi, 1894, p. 307.

[2] Knowlton, Bull. U. S. Geol. Survey, No. 163, p. 53, pl. xiii, figs. 3-5, 1900.

[3] Based on *Brasenia antiqua* Dawson, Trans. Roy. Soc. Canada, vol. iii, sec. iv, p. 15, tf., 1886.

Description.—" L. foliolis parvulis, ovalibus, breviter petiolatis, nervis secundariis distantibus, curvatis, subtilissimis."—Heer, 1874.

Leaflets small, oval and unsymmetrical in outline. Length ranging from 1.5 cm. to 2.8 cm. Width ranging from 8.5 mm. to 12 mm. Margins entire. Petiolule short. Midrib stout. Secondaries thin, remote, three to five pairs, alternate, camptodrome, often obsolete.

Leguminous leaflets from a number of widely removed localities have been referred to this species, and while all of these are very similar in general characters their positive identity cannot be affirmed with any great confidence. Described originally from the Atane beds of Greenland, they have been detected by Lesquereux in the Dakota group, by Newberry in the Raritan formation, by Hollick at Marthas Vineyard and Staten Island, and by the writer from Maryland. They are very similar to other species of *Leguminosites,* as, for example, *Leguminosites frigidus* Heer [1] described from the Patoot beds.

Professor Heer in his last report (*loc. cit.*) refers this form to the old world genus *Colutea,* but it does not seem wise to follow him in this reference with no more evidence than is available.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

LEGUMINOSITES CANAVALIOIDES n. sp.

Plate LXXVI, Fig. 6

Description.—Leaves compound, probably trifoliate. Leaflets large, elliptical in general outline, with a rounded apex and base. Length about 7 cm. Maximum width, in the middle part of the leaflet, about 6 cm. Margins entire. Texture subcoriaceous. Petiolule wanting. Midrib stout, becoming attenuated diatad. Secondaries numerous, thin, camptodrome, about ten pairs, diverging from the midrib at angles of about 55°. Tertiary areolation papilionaceous, mostly immersed.

This species respresents a leguminous leaflet of unknown generic affinity named from its resemblance to the leaflets of the existing species

[1] Heer, Fl. Foss. Arct., Bd. vii, p. 44, pl. lv, figs. 21, 22; pl. lxv, fig. 13, 1883.

Canavalia, which number about a dozen, of the tropics of both hemispheres. In the Lower Eocene of southeastern North America there is an undoubted species of *Canavalia* very close to the existing *Canavalia obtusifolia* (Lamarck) D. C., a common West Indian strand plant.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

LEGUMINOSITES OMPHALOBIOIDES Lesquereux

Plate LXXVI, Fig. 5

Leguminosites omphalobioides Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, pl. xxxviii, fig. 4.

Leguminosites omphalobioides Newberry, 1896, *Ibidem,* vol. xxvi, p. 97, pl. xlii, fig. 39.

Leguminosites omphalobioides Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 24.

Leguminosites omphalobioides Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 155.

Description.—Leaflets elliptical in outline, 3.2 cm. to 4 cm. in length by 1.5 cm. to 1.7 cm. in greatest breadth, which is about half-way between the apex and the base. Texture subcoriaceous. Apex rather broadly rounded. Base slightly narrowed and decurrent to the point of attachment. Lesquereux speaks of a short petiole, but this is lacking in his type figure and in all the specimens examined by the writer. The midrib is not especially wide, but is quite prominent. The secondaries are thin and alternate; they number about six pairs, and branch from the midrib at angles of 50°, or somewhat less, curving upward close to the margins, camptodrome.

This species was described originally from the Dakota group of Kansas, and subsequently found in the Magothy formation of Maryland and the Tuscaloosa formation of Alabama.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

Genus LIRIODENDROPSIS Newberry

[Mon. U. S. Geol. Survey, vol. xxvi, 1896, p. 82]

LIRIODENDROPSIS CONSTRICTA Ward

Liriodendropsis simplex Hollick, 1893, Trans. N. Y. Acad. Sci., vol. xii, p. 235, pl. vii, fig. 3.

Liriodendropsis simplex constricta Ward, 1896, 16th Ann. Rept. U. S. Geol. Survey, pt. i, p. 540, pl. ci, fig. 8.

Liriodendropsis constricta Hollick, 1907, Mon. U. S. Geol. Survey, vol. l. p. 71, pl. xxii, fig. 7; pl. xxvi, figs. 6-15; pl. xl, fig. 15.

Description.—Leaves ovate in general outline with a rounded ultimately cuneate base, constricted abruptly on each side the apical portion narrowed and straight-sided with an emarginate apex. Length ranging from 4 cm. to 9 cm. Maximum width, in the basal part, ranging from 2 cm. to 4 cm. Secondary and tertiary venation indistinguishable from that of *Liriodendropsis simplex* or *angustifolia* of one or the other of which it is probably a variant and not a distinct species.

Forms answering to the foregoing diagnosis are recorded from Marthas Vineyard, Massachusetts, and Glen Cove, Long Island, where they are associated with large numbers of leaflets of *Liriodendropsis simplex* and *angustifolia*. A single leaflet is likewise associated with these two species in Alabama which fact lends emphasis to its doubtful specific rank. The Maryland material is rare and not positively determined.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

Genus COLUTEA Linné

[Sp. Pl., 1753, p. 723]

COLUTEA OBOVATA Berry

Plate LXXVI, Figs. 1, 2

Colutea obovata Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 175, figs. 5, 6.

Description.—Leaves small, ovate in general outline, inequilateral, with rounded margins and apical auricles separated by a deep and rounded sinus. The Tuscaloosa leaf is somewhat smaller than the type and measures 1.3 cm. along the midrib, 1.6 cm. from apices to base, and 1.2 cm.

in greatest width, which is the distal half of the leaf. Base cuneate. Midrib slightly curved. Secondaries four or five subopposite pairs which are thin, ascending and camptodrome. Tertiaries fine.

This small species was described by the writer from material collected in the Magothy formation of Maryland and it is also found in the Tuscaloosa formation of Alabama. It appears to be entirely distinct from the other known Cretaceous species, of which there are several. It resembles more or less some of the various leaves which have been identified as *Colutea primordialis* Heer from Greenland, the Atlantic Coastal Plain, and the Western Interior.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

COLUTEA PRIMORDIALIS Heer

Plate LXXV, Fig. 3

Colutea primordialis Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 99, pl. xxvii, figs. 7-11; pl. xliii, figs. 7, 8.

Colutea primordialis Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 148, pl. xiii, figs. 8, 9.

Colutea primordialis Hollick, 1894, Bull. Torrey Bot. Club, vol. xxi, p. 56, pl. clxxiv, fig. 2.

Colutea primordialis Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 97, pl. xix, figs. 4, 5.

Colutea primordialis Hollick, 1907, *Ibidem*, vol. l, p. 84, pl. xxxii, figs. 14, 15.

Colutea primordialis Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 24.

Colutea primordialis Berry, 1911, *Ibidem*, vol. xxxviii, p. 407.

Colutea primordialis Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 156, pl. xx, fig. 4.

Description.—" C. foliolis membranaceis, breviter petiolatis, pollicaribus, ovalibus, integerrimis, basi attenuatis, apice profunde emarginatis, nervis secundariis subtilissimis, camptodromis."—Heer, 1882.

This species was described from the Atane beds of west Greenland and subsequently recorded from the Dakota sandstone of Kansas, the Raritan formation of New Jersey, and the Magothy formation of Marthas Vineyard and Long Island. Typical forms are not uncommon in the upper part of the Magothy formation at Grove Point.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

Genus BAUHINIA Linné
[Sp. Pl., 1753, p. 374]

BAUHINIA MARYLANDICA Berry

Plate LXXV, Figs. 5-7

Bauhinia marylandica Berry, 1908, Torreya, vol. viii, p. 218, figs. 1-3.

Description.—Leaves small, about 3 cm. in greatest length by 2.5 cm. in greatest breadth, elliptical in general outline, bilobate; the apical sinus narrow and pointed, reaching one-half to two-thirds of the distance to the base; lobes narrow, ascending, somewhat falcate in outline, obtusely pointed; midrib straight, giving off one, two or three sharply ascending pairs of opposite, camptodrome secondaries, these give off a series of broadly rounded inequilateral tertiary arches which are directed upward and outward; the upper pair of secondaries the most prominent; from the juncture of the midrib and sinus a pair of much reduced secondaries is given off and these join the secondary next below in one or two broad arches.

The present species was described in 1908 from the Magothy formation at Grove Point, Maryland, where it is abundant. It is sparingly represented in the lower part of the Tuscaloosa formation of western Alabama.

The form and venation of these leaves are exactly like several of the existing species of *Bauhinia,* and are so well marked that there can be no doubt of the existence of a species of *Bauhinia* growing along the middle and south Atlantic coast during the deposition of the Upper Cretaceous, a species whose descendants along with those of its congeners migrated finally to their present tropical habitat, perhaps gradually with the oscillation of climatic conditions, and perhaps not until the Pleistocene glaciation to the northward forced them to make a comparatively sudden retreat to the southward.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County, Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Genus DALBERGIA Linné, f.
[Suppl., 1781, p. 52]

DALBERGIA SEVERNENSIS Berry

Plate LXXVI, Fig. 3

Dalbergia severensis Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 407, pl. xix, fig. 2.

Description.—Leaflets of rather small size, oblanceolate in general outline, with a markedly emarginate apex, gently curved sides and narrowly pointed base. Length about 5 cm. Maximum width, in the middle part of the leaf, about 1.5 cm. Margins entire. Texture subcoriaceous. Petiolule wanting. Midrib stout below, thin above. Secondaries thin, five or six pairs, diverging from the midrib at angles of 45° or less, the lower ascending, the upper curved, all eventually camptodrome.

This handsome form is clearly distinct from related forms and is identical in its characters with the fossil leguminous leaflets usually referred to the genus *Dalbergia*. The modern species number about four score distributed throughout the Oriental and Occidental tropics, and there is a strong generic similarity in their foliage. The fossil species of *Dalbergia* are numerous, extending from the Upper Cretaceous through the Tertiary.

Occurrence.—MAGOTHY FORMATION. Little Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Order GERANIALES

Family EUPHORBIACEAE

Genus CROTONOPHYLLUM Velenovsky
[Květena českého cenomanu, 1889, p. 20]

CROTONOPHYLLUM CRETACEUM Velenovsky

Plate LXXVI, Figs. 7, 8

Crotonophyllum cretaceum Velenovsky, 1889, Květena českého cenomanu, p. 20, pl. v, figs. 4-11.

Crotonophyllum cretaceum Frič and Bayer, 1901, Archiv. Naturw. Landes. Böhm., Bd. xi, Nr. ii, p. 137, tf. 101.

Description.—Leaves of variable size and form, in general ovate to lanceolate in outline, with a sharply pointed apex and decurrent base. Length ranging from 9 cm. to 15 cm. Maximum width, usually in the middle part of the leaf, ranging from 2 cm. to 5 cm. Petiole stout. Midrib stout and slightly flexuous, prominent. Secondaries numerous, camptodrome, their angle of divergence and subsequent course dependent on the shape of the individual leaves; in general they diverge at an acute angle and are ascending. Texture coriaceous.

These leaves exhibit a wide range of variation, some forms being entire and lanceolate, with the margins but slightly undulate. Usually these undulations are pronounced, one or more on either one or both sides of the lamina becoming emphasized to form a pronounced constriction. These sinuses are sometimes rounded, more often they are sharply pointed and extend about half-way to the midrib. These constrictions may be in the apical, median or basal region. Usually they are above the middle and divide the leaf into a lower ovate portion and an upper linear-lanceolate portion.

This species, which is the type of the genus, was described by Velenovsky (in Bohemian) in 1889 from the Cenomanian of Vyšerovic, Bohemia, and compared with existing species of Croton, some of which it greatly resembles. It remained the only species until recently when the writer described[1] the closely related *Crotonophyllum panduræformis* from the Middendorf beds of South Carolina and the Tuscaloosa formation of Alabama. A previously described form which while much smaller is otherwise quite similar to the widest Maryland specimen is *Cinnamomum membranaceum* (Lesquereux) Hollick.[2]

The genus is also represented in the Lower Eocene flora of the Mississippi embayment.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

[1] Berry, Prof. Paper U. S. Geol. Survey, No. 84, p. 48, pl. vii, figs. 5-10, 1914.
[2] Hollick, Mon. U. S. Geol. Survey, vol. l, 1907, p. 75, pl. xxix, figs. 5, 6.

Order SAPINDALES

Family ILICACEAE

Genus ILEX Linné

[Sp. Pl., 1753, p. 125]

ILEX SEVERNENSIS Berry

Plate LXXVII, Figs. 1, 2

Ilex severnensis Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 407, pl. xix, figs. 1, 1a.

Description.—Leaves of small size, oblong in general outline, with a cuspidate apex and a narrowly rounded base. Length about 2 cm. Maximum width about 6.5 cm. Texture coriaceous. Margins entire below; above, with a few irregularly spaced salient serrate teeth. Midrib relatively stout. Secondary venation thin and more or less obsolete, consisting of a vein which forms a marginal hem all around and numerous transverse veins between it and the midrib. The latter are for the most part nearly straight, diverging from the midrib at angles of about 90°, giving the leaf a scalariform appearance, as shown in the enlarged figure of this form.

Occurrence.—MAGOTHY FORMATION. Little Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Family CELASTRACEAE

Genus ELAEODENDRON Jacques, f.

[Nova Acta Helv., vol. 1, 1787, p. 36]

ELÆODENDRON MARYLANDICUM Berry

Plate LXXVII, Figs. 3-6

Elæodendron marylandicum Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 24, pl. viii, fig. 1.

Description.—Leaf orbicular in general outline, 6.5 cm. to 8.5 cm. in length by 4.7 cm. to 6.2 cm. in greatest width, which is about midway between the apex and the base. Apex evenly rounded, somewhat emarginate in one specimen. Base cuneate, slightly decurrent. Margin entire

below, furnished above with a few irregularly-spaced and very small spine-like teeth. Petiole extremely stout, 3 cm. long in one of the smaller specimens. Midrib also stout, thinning rapidly toward the tip. Secondaries five or six pairs, alternate, camptodrome, branching from the midrib at an angle of about 50° to 55° and curving slightly upward to join lateral branches from the secondaries next above. From the outer side of these successive arches short tertiaries run to the marginal teeth in those parts of the leaf in which the teeth are developed.

This very handsome and well-marked species is represented by a number of specimens from Grove Point. It finds its nearest relative in certain of the larger and more orbicular variants of the upper Raritan and Magothy species *Celastrophyllum newberryanum* Hollick; in fact, it would seem reasonable to suppose that the present species which has thus far been found at the extreme top of the Magothy formation at Grove Point may be descended from *Celastrophyllum newberryanum,* which characterizes particularly the upper Raritan at South Amboy, New Jersey. The writer was long undecided whether or not to refer the new species to *Celastrophyllum* or *Elæodendron,* and it may also seem preferable eventually to transfer *C. newberryanum* to the latter genus, with which it shows many characters in common. The present species may be compared with *Elæodendron dioicum* Grisebach from the West Indies.

The genus *Elæodendron* has mainly a Tertiary history, although Hollick has described a Magothy species recently from Gay Head, Marthas Vineyard (*Elæodendron strictum*).

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—U. S. National Museum.

Genus CELASTRUS Linné

[Sp. Pl., 1753, p. 196]

CELASTRUS ARCTICA Heer

Plate LXXVII, Fig. 7

Celastrus arctica Heer, 1883, Fl. Foss. Arct., Bd. vii, p. 40, pl. lxi, figs. 5d, 5e.

Celastrus arctica Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 98, pl. xiii, figs. 8-18.

Celastrus arctica Hollick, 1898, Ann. N. Y. Acad. Sci., vol. xi, p. 60, pl. iv, fig. 8.

Celastrus arctica Hollick, 1904, Bull. N. Y. Bot. Garden, vol. iii, p. 408, pl. lxx, figs. 12, 13.

Celastrus arctica Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 88, pl. xxxiii, figs. 9-11.

Celastrus arctica Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 407.

Celastrus arctica Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 172, pl. xxv, figs. 1-5.

Description.—" C. foliis parvulis, lineari-lanceolatis, apice longe attenuatis, basi angustatis, denticulatis, nervis secundariis angulo acuto egredientibus."—Heer, 1883.

Leaves elongated and narrow, linear-lanceolate in outline, with an equally acuminate apex and base and a short stout petiole.[1] Length ranging from 4 cm. to 13 cm., width ranging from 0.5 cm. to 1.5 cm. Midrib stout. Secondaries numerous, parallel, nearly straight, branching from the midrib at acute angles which range from 12° to 37°, inosculating near the margin, short branches from this marginal hem entering the teeth. Margin regularly and somewhat remotely dentate with shallow rounded sinuses between the teeth, the cuneate base entire-margined.

This species, which is exceedingly abundant in the upper Raritan beds at South Amboy, but which has not been found elsewhere in the New Jersey Raritan, was described originally from the Patoot beds of Greenland which are usually correlated with the Senonian of Europe. It is abundant at the top of the Magothy formation in Maryland. The Greenland material was limited and the specimens were small in size compared with the usual Raritan forms. There is, however, no question of their identity.

Professor Heer (*op. cit.*) compared this species with *Celastrus ettingshauseni*[2] of the European Tertiary which resembles a number of modern species of *Celastrus* of the East Indian region.

The present species exhibits considerable resemblance to the leaflets of the palmately compound Dewalqueas of the Upper Cretaceous and Lower

[1] A single specimen from Little Round Bay has a petiole 2 cm. in length.

[2] Heer, Fl. Tert. Helv., Bd. iii, 1859, p. 68, pl. cxxi, figs. 46, 46b (non Velenovsky, 1882).

Eocene, but no evidence of a similar habit is indicated among the large number of specimens collected by the writer.

This species is recorded by Hollick from Block Island and Long Island, and is also present in the Kreischerville beds of Staten Island.

Occurrence.—MAGOTHY FORMATION. Little Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Genus CELASTROPHYLLUM Goeppert
[Tertiärfl. Java, 1854, p. 52]

CELASTROPHYLLUM CRENATUM Heer (?)

Celastrophyllum crenatum Heer, 1885, Fl. Foss. Arct., Bd. vii, p. 41, pl. lxii, fig. 2.

Celastrophyllum crenatum Smith, 1894, Geol. Coastal Plain Ala., p. 348.

Celastrophyllum crenatum Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 99, pl. lxviii, figs. 1-18.

Celastrophyllum crenatum Berry, 1907, Bull. Torrey Bot. Club, vol. xxxiv, p. 197, pl. xiii, fig. 5.

Celastrophyllum crenatum Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 178, pl. xxii, fig. 9; pl. xxiii, fig. 2.

Celastrophyllum crenatum Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 50.

Description.—Leaves very variable in size, 2 cm. to 8 cm. in length by 1 cm. to 5 cm. in width, ovate or elliptical in outline, broadly rounded above, narrowed and generally inequilateral below. Margins entire below, coarsely toothed above, with somewhat variable, rounded, crenate or crenate-dentate teeth. Occasional specimens are entire throughout and some have a markedly inequilateral base. Midrib mediumly stout. Secondaries numerous, nine or ten pairs, subopposite, branching from the midrib at angles somewhat in excess of 45°, slightly curved upward and parallel, branching near the margin to form festoons from which branches enter the marginal teeth.

This species was described originally by Professor Heer from the Patoot beds of Greenland, and unfortunately only a single small leaf was figured. The Raritan leaves, which are abundant, grade into much larger forms which are also present in the Black Creek formation of North Carolina and the Tuscaloosa formation of Alabama.

The species is rare in South Carolina, fragmentary specimens being sparsely represented in the Middendorf beds. It is represented by fragmentary and not certainly determined specimens in the Maryland Magothy. The genus is characteristic of the late Lower and early Upper Cretaceous of eastern North America.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

CELASTROPHYLLUM UNDULATUM Newberry (?)

Celastrophyllum undulatum Smith, 1894, Geol. Coastal Plain. Ala., p. 348 *(nomen nudum).*

Celastrophyllum undulatum Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. xxxviii, figs. 1-3.

Celastrophyllum undulatum Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 198.

Celastrophyllum undulatum Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 175.

Description.—Leaves of large size, 10 cm. to 15 cm. in length by 4 cm. to 8 cm. in width, ovate-oblong or ovate in outline, with an obtuse or bluntly pointed apex and somewhat narrowed base. Margin strongly undulate or broadly and coarsely crenate, somewhat variable in the character of its teeth. Midrib stout. Secondaries numerous, a dozen or more subopposite pairs, which branch from the midrib at a wide angle and fork near the margins to form festoons which coincide approximately with the marginal teeth.

This very large species resembles the larger leaves that are referred to *Celastrophyllum crenatum* Heer, but is much larger and more elongate in outline. Its size has apparently rendered perfect specimens rare and the recovered remains are usually fragmentary. Velenovsky hints at its identity with the leaves named by him *Myrica zenkeri* from the Bohemian Cretaceous, although this resemblance is obviously slight, the present species more nearly resembling the Bohemian leaves which this author identifies as a species of *Ternstrœmia,* as well as various lower Eocene species of *Ternstroemites* of the Mississippi embayment area.

It was described originally from the New Jersey Raritan and is represented by considerable fragmentary material in the lower Tuscaloosa beds of Alabama. Large leaves of this species occur in the Black Creek beds of North Carolina. Doubtfully determined material is present in Maryland.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Order RHAMNALES

Family RHAMNACEAE

Genus RHAMNITES Forbes

[Quart. Jour. Geol. Soc. Lond., vol. vii, 1851, p. 103]

RHAMNITES APICULATUS Lesquereux

Plate LXXVIII, Fig. 3

Rhamnites apiculatus **Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 171, pl. xxxvii, figs. 8-13.**

Rhamnites apiculatus **Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 25.**

Description.—" Leaves small, coriaceous, short petioled, entire, ovate, obovate or elliptical, rounded at apex to an apiculate point; primary nerve narrow, secondaries thin, camptodrome, curving to and along the borders.

" Base more or less narrowly attenuated either acutely or broadly cuneiform, apex rounded, tipped by a minute point or mucro. According to the width of the cuneate base the secondaries are at a more or less acute angle of divergence, the lowest pairs branching and anastomosing in areoles along the borders, the upper more open, shorter and parallel. The size of the leaves varies little, being from 3 cm. to 4 cm. in length, and from 17 mm. to 25 mm. in width, measured either above or below the middle; some of the leaves are obovate, others nearly regularly oval, others still more enlarged above the base and ovate."—Lesquereux, 1892.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Family VITACEAE

Genus CISSITES Heer

[Phyll. Crét. Nebr., 1866, p. 19]

CISSITES FORMOSUS MAGOTHIENSIS Berry

Plate LXXVIII, Fig. 4

Cissites formosus magothiensis Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 25.

Description.—Leaves trilobate, consisting of an elongated terminal lobe and two lateral lobes which diverge from it at angles of about 45°. The lobes may be entire or sublobate, with rounded tops, and separated by open rounded sinuses reaching about half-way to the base which is broadly cuneate. Length about 11 cm. to 12 cm. Maximum width, from tip to tip of the lateral lobes, about 9 cm. Margins entire. Midrib stout, becoming thin distad. Lateral primaries supra-basilar, subopposite, thinner than the midrib. Secondaries thin, numerous, camptodrome, except for a craspedodrome one running to the broadly rounded tip of each subordinate lobe.

Cissites formosus was described by Heer[1] from the Atane beds of West Greenland, and it has been recorded from the Dakota sandstone of the West and the Raritan formation of New Jersey. The present variety differs from the type in lacking the long bifurcated lateral lobes, in the more elongated terminal lobe and the less development of subordinate lobation. It is confined to the Magothy formation of Maryland, but may be compared with *Cissites dentato-lobatus* Lesquereux of the Dakota group, and *Cissites vitifolia* Velenovsky of the Cenomanian of Bohemia. All of these forms are probably descended from *Cissites parvifolius* Berry, which is so common in the Patapsco formation and the Albian of Portugal.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

[1] Heer, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 85, pl. xxi, figs. 5-8, 1882.

CISSITES NEWBERRYI n. sp.

Cissites crispus Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 108, pl. xlii, figs. 20-23 (non Velenovsky, 1885).
Cissites crispus Berry, 1906, Bull. Torrey Bot. Club, vol. xxxii, p. 177.
Cissites crispus Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 186.

Description.—Leaves of variable but small size, narrowly elliptical or obovate to nearly orbicular in general outline. Length ranging from 5.5 mm. to 2 cm. Maximum width, in the middle part of the leaf, ranging from 4 mm. to 1.75 cm. Apex broad or narrow, bluntly pointed. Base narrowly or broadly cuneate. Margins with relatively very large, somewhat irregular teeth, which are either serrate or dentate. Texture subcoriaceous. Petiole relatively long and stout, about one-half the length of the lamina. Midrib curved or flexuous, thin. Secondaries thin, two or three opposite to alternate pairs, diverging from the the midrib at acute angles, indifferently camptodrome or craspedodrome. Tertiaries obsolete.

This species, while it resembles *Cissites crispus* Velenovsky[1] and is probably related to it, is entirely distinct. This is especially true of the Magothy leaves contained in carbonate of iron nodules which the writer has identified as this species from New Jersey and Delaware, both this and the Raritan determinations are therefore referred to a new species named in honor of the late Professor Newberry.

It differs from *Cissites crispus* by its relatively longer and narrower form; its serrate and dentate instead of crenate teeth; its more ascending and frequently camptodrome secondaries; its obsolete tertiaries; and its cuneate instead of markedly cordate base.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

[1] Velenovsky, Fl. Böhm. Kreidef. Theil iv, 1885, p. 12, pl. iv, fig. 6.

Order MALVALES

Family STERCULIACEAE

Genus STERCULIA Linné

[Sp. Pl., 1753, p. 1007]

STERCULIA MINIMA Berry

Plate LXXX, Figs. 1-3

Sterculia mucronata Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 90, pl. xliii, fig. 3.

Sterculia minima Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 177.

Sterculia minima Berry, 1906, Ann. Rept. State Geol Survey of New Jersey for 1905, pp. 139, 140, 141, 152.

Description.—Leaves of small size, digitately bilobate, trilobate, quadrilobate (and probably quinquelobate, although the latter type has not been discovered). Length ranging from 3.75 cm. to 6.5 cm. Maximum width from tip to tip of the lateral lobes ranging from 3 cm. to 7 cm. Leaf substance subcoriaceous. Margins entire. Lobes narrow, acutely pointed, somewhat conical, diverging from one another at angles of about 35°, separated by usually deep sinuses, rounded at their angles and extending to or, usually, below the middle of the leaf. Leaf base broadly cuneate or rounded. Primaries two or three, of aproximately equal caliber, diverging from one another at angles of about 35° some distance above the base of the leaf. Petiole not preserved, probably relatively long or it would not furnish sufficient leverage to break the leaf across the base of the primaries as is the case in nearly every specimen. Secondaries mostly immersed in the leaf-substance, a few that are visible show that they diverge from the primaries at wide angles, at frequent, more or less regular, intervals and have their ends connected by flat wide arches close to the margins.

The present species is the smallest of the American Cretaceous species of *Sterculia,* although some of the smaller forms approach it in size and appearance. It may be distinguished from the latter by its smaller size, its less conical lobes, directed upward instead of laterally, and its suprabasilar primaries.

In common with numerous existing and fossil species of *Sterculia* it is an exceedingly variable form in the number of its lobes, but is otherwise well characterized. It is only known from the Magothy formation and ranges from Raritan Bay, in New Jersey, to Maryland. The modern species of *Sterculia* number upwards of one hundred. They are divided into three sections, Digitatæ, Lobatæ, and Integrifoliæ. The first is almost entirely oriental (farther India to New South Wales) with only one endemic American species (in Mexico). The second is found in Asia, Africa, Australia, and America. It contains more existing species in America than either of the other two sections and all of the rather numerous Middle Cretaceous species of America, including the present form, appear to belong in this section. The third section is represented in the modern flora of Asia, Africa, and America (five or six species).

The present species is not unlike some of the smaller forms of *Sterculia mucronata* Lesquereux[1] It is also very similar to and probably represents an ancestral form of *Sterculia labruscoides* Berry, a Middle Eocene (Claiborne) species of the Mississippi embayment region. Several recent tropical American species of the section Lobatæ resemble it more or less closely. Perhaps the most similar modern form is *Sterculia diversifolia* Don, especially the variety *occidentalis* Bentham of the Australian region as pointed out by the writer in 1903.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County, Maryland; Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

STERCULIA CLIFFWOODENSIS Berry

Plate LXXX, Fig. 4

Sterculia cliffwoodensis Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 88, pl. xliii, fig. 5.

Sterculia cliffwoodensis Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 178.

---

[1] Lesquereaux, Mon. U. S. Geol. Survey, vol. xvii, 1892, p. 182, pl. xxx, figs. 1-4.

Description.—Leaves of relatively large size, palmately trilobate, with a somewhat decurrent base, divided three-fourths of the distance to the base by openly cuneate, ultimate rounded sinuses. Lobes diverging at angles of from 45° to 50°, linear-lanceolate or slender-conical, elongated, acuminate, the middle one the same size as or slightly wider than the later lobes. Margins entire. Texture subcoriaceous. Length about 17 cm. Petiole stout, its length unknown. Midrib straight, stouter than the lateral primaries. Lateral primaries suprabasilar, never observed to be opposite, but diverging from the midrib at angles of about 45° from 2 mm. to 4 mm. apart, slightly curved at first and then straight to the tip of the lateral lobes. Secondaries thin, often obsolete, diverging from the primaries at wide angles, often approaching 90°, straight for two-thirds to three-fourths of the distance to the margins where they turn abruptly upward to form flat arches joining the secondaries next above. Tertiaries thin, usually obsolete, forming relatively large three-sided, four-sided, or five-sided, mostly isodiametric meshes.

This handsome species is unfortunately represented by very fragmentary material, the long slender lobes being usually broken away. It was described from Cliffwood Bluff, New Jersey, in 1903, and subsequently detected near the eastern border of Maryland. It is rather close to *Sterculia lugubris* Lesquereux [1] from the Dakota group, a species that has been tentatively identified by the writer [2] from the Woodbine formation of northeastern Texas. The latter has more ascending lobes, which are also somewhat widened medianly. It has much stouter primaries, the laterals being opposite and basal.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

[1] Lesquereux, Cret. and Tert. Fl., p. 81, pl. vi, figs. 1-3, 1883.

[2] Berry, Bull. Torrey Bot. Club, vol. xxxix, p. 399, pl. xxxi, fig. 3, 1912.

Order THYMELEALES

Family LAURACEAE

Genus CINNAMOMUM Sprengel

[Anleit., Bd. ii, 1818, p. 340]

CINNAMOMUM NEWBERRYI Berry

Plate LXXI, Fig. 6

Cinnamomun sezannense Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 77, pl. xix, fig. 8; pl. xxxiii, figs. 11, 12 (non Watelet).

Cinnamomum sezannense Heer, 1883, *Ibidem*, Bd. vii, p. 30, pl. lxi, fig. 1a (non Watelet).

Cinnamomum sezannense Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 107, pl. xii, fig. 7 (non fig. 6, which is a leaf of *Cinnamomum membranaceum* (Lesquereux) Hollick).

Cinnamomum sezannense Dawson, 1894, Trans. Roy. Soc. Canada, 1st ser., vol. xi, sec. iv, p. 64, pl. xiii, fig. 58 (non Watelet).

Cinnamomum sezannense Hollick, 1894, Bull. Torrey Club, vol. xxi, p. 53, pl. clxxx, figs. 5, 7 (non Watelet).

Cinnamomum intermedium Smith, 1894, Geol. Coastal Plain in Ala., p. 348 *(nomen nudum)*.

Cinnamomum intermedium Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 89, pl. xxix, figs. 1-8, 10 (non Ettingshausen).

Cinnamomum intermedium Hollick, 1901, Mon. U. S. Geol. Survey, vol. i, p. 74, pl. xxix, fig. 7; pl. xxx, figs. 1, 2 (non Ettingshausen).

Cinnamomum sezannense Penhallow, 1902, Trans. Roy. Soc. Canada, 2d ser., vol. viii, sec. iv, p. 46 (non Watelet).

Cinnamomum sezannense Hollick, 1903, Ann. Rept. N. Y. State Mus., 55th for 1901, p. r. 50.

Cinnamomum intermedium Berry, 1906, Rept. State Geol. of New Jersey for 1905, p. 139, pl. xx, figs. 2-6 (non Ettingshausen).

Cinnamomum intermedium Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 179, pl. vii, figs. 3, 4.

Cinnamomum intermedium Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 27, (non Ettingshausen).

Cinnamomum newberryi Berry, 1911, *Ibidem*, vol. xxxviii, p. 423.

Cinnamomum newberryi Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 150, pl. xvi, fig. 3.

Cinnamomum newberryi Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, pp. 54, 117, pl. ix, figs. 12, 13; pl. xxi, figs. 9-11.

Description.—Leaves ovate-lanceolate in outline, 7 cm. to 12 cm. in length by 2.3 cm. to 4 cm. in width. Apex usually obtusely pointed, sometimes acute. Below narrowed to an acute base. Petiole stout. Venation stout. Primaries three, the laterals diverging from the midrib at acute

angles usually some distance above the base, and traversing at least more than half the distance to the tip. Secondaries in the upper half of the leaf, three or four pairs, alternate, camptodrome. The laterals give off numerous camptodrome branches on the outside.

This species is quite common in the Raritan formation of New Jersey at nearly all of the fossiliferous localities, and it has also a considerable additional range, extending eastward on Long Island and southward through Delaware and Maryland to Alabama. A very similar leaf which is widely distributed in the Cenomanian of Bohemia is identified by Velenovsky[1] as

Numerous occurrences of *Cinnamomum newberryi* have been confused with the European Lower Eocene species *Cinnamomum sezannense* Watelet, although the two are perfectly distinct.

Occurrence.—RARITAN FORMATION. East Washington Heights, District of Columbia. MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Round Bay and Little Round Bay, Anne Arundel County, Maryland.

Collections.—Maryland Geological Survey, U. S. National Museum.

Genus LAURUS Auct.

LAURUS PLUTONIA Heer

Plate LXXI, Fig. 5

Laurus plutonia Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 75, pl. xix, figs. 1d, 2-4; pl. xx, figs. 3a, 4-5; pl. xxviii, figs. 10, 11; pl. xliii, figs. 4b.

Laurus plutonia Heer, 1883, *Ibidem*, vol. vii, p. 30, pl. xlviii, fig. 2; pl. lxii, fig. 1a.

Laurus plutonia Velenovsky, 1884, Fl. Böhm. Kreidef. Theil iii, p. 1, pl. iv, figs. 2-4.

Laurus plutonia Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 91, pl. xiii, pt. i, p. 14; pl. A, fig. 6; pl. B, fig. 5.

Laurus plutonia Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 85, pl. xvi, figs. 10, 11.

Laurus plutonia Hollick, 1898, Ann. N. Y. Acad. Sci., vol. xi, p. 60, pl. iv, figs. 6, 7.

Laurus plutonia Frič and Bayer, 1901, Archiv. Naturw. Landes. Böhm., Bd. xi, Nr. ii, p. 130, tf. 94.

Laurus plutonia Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 79, pl. i, figs. 9-11.

---

[1] Velenovsky, Fl. Böhm. Kreidef. Theil i, p. 30, pl. vii, figs. 5-8, 10; pl. viii, figs. 1-5, 1882.

Laurus plutonia Berry, 1906, Bull. Torrey Bot. Club, vol. xxxi, p. 77, pl. iii, fig. 1.

Laurus plutonia Berry, 1906, *Ibidem*, vol. xxxiii, p. 178.

Laurus plutonia Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 80, pl. xxvii, figs. 9, 11; pl. xxviii, figs. 1, 2.

Laurus plutonia Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 26.

Laurus plutonia Berry, 1912, *Ibidem*, vol. xxxix, p. 401.

Laurus plutonia Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 86, p. 52, pl. xi, fig. 2; pl. xiii, fig. 6.

Description.—Leaves lanceolate in outline, usually tapering almost equally in both directions, but sometimes less acute at the base. Length 7 cm. to 11 cm. Maximum width 1.5 cm. to 2.5 cm. Midrib mediumly stout. Petiole short and stout, 6 mm. to 15 mm. in length. Secondaries slender, eight or more alternate pairs, camptodrome.

This species was described by Heer from the Atane beds of Greenland, and a large number of somewhat variable and fragmentary specimens were figured.

Subsequent to its description by Professor Heer, this species was recorded from a very large number of Cretaceous plant beds so that its present range, both geographical and geological, is rather wide. A number of these records are not entirely above question, and this appears to be especially true of the forms from the Cenomanian of Bohemia which Velenovsky so identifies (*op. cit.*).

Laurus plutonia is evidently a rare plant in the Raritan formation, but becomes abundant in immediately succeeding floras, being common in that of the Dakota group of the West, and in the Magothy formation of the East, at a number of localities in New Jersey and Maryland. It is a common form in the insular Cretaceous floras, and also occurs in the Tuscaloosa, Woodbine and Eutaw formations of the Gulf Coastal Plain. Supposed fruits are figured by Heer (*loc cit.*, pl. xlii, fig. 4b). In South Carolina this species is represented by typical leaves which are not at all uncommon in the Middendorf beds. It has not yet been detected in the North Carolina Cretaceous.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County; Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

LAURUS HOLLICKII Berry

Plate LXXI, Fig. 4

Laurus hollickii Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 79, pl. lii, fig. 4.

Laurus hollickii. Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 77, pl. iii, fig. 2.

Laurus hollickii Berry, 1906, *Ibidem*, vol. xxxiii, p. 178.

Laurus hollickii Berry, 1906, Ann. Rept., State Geol. Survey of New Jersey for 1905, pp. 138-141.

Laurus hollickii Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 26.

Description.—Leaves of variable size, lanceolate in general outline, the apex and base about equally acuminate. Length ranging from 4 cm. to 8 cm. Maximum width, in the middle part of the leaf, ranging from 8 mm. to 14 mm. Margins entire, evenly rounded. Texture subcoriaceous. Midrib stout, straight or curved. Secondaries thin but prominent, distant, usually evenly spaced, about five pairs, diverging from the midrib at acute angles, ascending, evenly curved, dying out by diminishing camptodrome inosculations along the borders. Tertiaries obsolete.

This characteristic small lauraceous form is common in the Magothy formation to which it is confined. It ranged from Raritan Bay in New Jersey to the Severn River in Maryland, and suggests numerous modern species of *Nectandra* as well as various early Eocene species of this genus.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Round Bay, Little Round Bay, Anne Arundel County, Maryland.

Collection.—Maryland Geological Survey.

LAURUS PROTEÆFOLIA Lesquereux

Plate LXXV, Fig. 1

Laurus proteæfolia Lesquereux, 1876, Bull. U. S. Geol. and Geog. Survey Terr., vol. i, 1875, p. 393.

Laurus proteæfolia Lesquereux, 1876, Ann. Rept. U. S. Geol. and Geog. Survey Terr. for 1874, p. 342, pl. v, figs. 1, 2.

Laurus proteæfolia Lesquereux, 1883, Cret. and Tert. Flora, p. 52, pl. iii, figs. 9, 10; pl. xvi, fig. 6.

Laurus proteæfolia Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 92.

Laurus proteæfolia Knowlton, 1901, 21st Ann. Rept. U. S. Geol. Survey, pt. vii, p. 318.

Laurus proteæfolia Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 78, pl. xlvii, fig. 9; pl. xlix, fig. 6.

Laurus proteæfolia Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 78, pl. i, fig. 10.

Laurus proteæfolia Berry, 1905, *Ibidem*, vol. xxxii, p. 46, pl. ii, fig. 3.

Laurus proteæfolia Berry, 1906, Ann. Rept. State Geol. Survey of New Jersey for 1905, p. 138.

Laurus proteæfolia Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 26.

Description.—" Leaves subcoriaceous, broadly lanceolate, gradually narrowed from below the middle into a long acumen, more rapidly narrowed to the base; middle nerve narrowly grooved and comparatively narrow; lateral veins oblique, slender, curving to and along the borders, parallel, except the lower pair, which is more oblique and ascends higher."—Lesquereux, 1876.

This species was described originally from the Dakota group and has a considerable range in the American Upper Cretaceous, being recorded from the Woodbine formation of Texas and not at all rare in the Magothy formation from New Jersey to Maryland. It greatly resembles certain undescribed Wilcox Eocene species of *Nectandra* and *Oreodaphne,* as well as various existing tropical American species in these two genera.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County; Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

Genus LAUROPHYLLUM Goeppert

[Tertiärfl. Java, 1854, p. 45]

LAUROPHYLLUM ELEGANS Hollick

Plate LXXI, Figs. 1-3

Laurus plutonia Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xi, p. 99, pl. iii, figs. 3, 4 (non Heer).

Laurus plutonia Hollick, 1893, *Ibidem*, vol. xi, p. 236, pl. vi, fig. 1 (non Heer).

Proteoides daphnogenoides Hollick, 1898, Ann. N. Y. Acad. Sci., vol. xi, p. 420, pl. xxxvi, fig. 2 (non Heer).

Laurophyllum elegans Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 81, pl. xxvii, figs. 1-5.

Laurophyllum elegans Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, pp. 26, 198.

Laurophyllum elegans Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 53, pl. xii, fig. 6.

Description.—Leaves elongate-lanceolate, somewhat flexuous, about 12 cm. to 13 cm. in length by about 2 cm. in greatest width, which is about midway between the apex and the base; from this point they narrow gradually apically into an attenuated acuminate, usually curved, tip; and basally into a long, narrowly cuneate base. Midrib and petiole stout. Secondaries numerous, usually less close and somewhat coarser than in *Laurophyllum nervillosum,* branching from the midrib at an acute angle below, which becomes more open above the base of the leaf; they are usually more curved than in *L. nervillosum* and more distinctly camptodrome. Tertiaries transverse throughout.

These leaves were recorded originally by Hollick as *Laurus plutonia* Heer and were later compared with *Laurus angusta* Heer, which latter species they resemble more than they do the former. In outline they are not unlike *Laurophyllum angustifolium* Newberry from the Raritan formation of Woodbridge, New Jersey, but differ decidedly in venation. They are also similar to, but quite distinct from, *Laurophyllum nervillosum* Hollick of the Magothy and *Laurophyllum reticulatum* Lesquereux of the Dakota group.

The types were from transported materials associated with the terminal moraine, from which numerous specimens have been collected. Those from Tottenville, Staten Island, are undoubtedly of Raritan age, while those from Glen Cove were probably from the Magothy formation. The species is certainly known from the upper Raritan at South Amboy, New Jersey, and is common in the Magothy formation of Maryland. It is sparsely represented in the Black Creek beds of North Carolina and is not uncommon near Middendorf, South Carolina.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County; Round Bay, Anne Arundel County.

Collection.—U. S. National Museum.

LAUROPHYLLUM ANGUSTIFOLIUM Newberry

Laurophyllum angustifolium **Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 86, pl. xvii, figs. 10, 11.**

Laurophyllum angustifolium **Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 80, pl. xlvii, figs. 1, 5, 8; pl. xlix, figs. 1-5.**

Laurophyllum angustifolium Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 178.

Description.—Leaves elongate-lanceolate, very symmetrical in outline, 10 cm. to 15 cm. in length by 1.5 cm. to 2 cm. in width, widest above the middle, tapering with almost straight sides to the elongate-acute base. Apex narrowed, subacute. Petiole short and stout. Midrib also stout. Secondaries fine, often obsolete, twelve to fifteen pairs, branching from the midrib at an angle of about 45° and curving upward, camptodrome. Texture subcoriaceous.

This species was originally described from the middle Raritan of New Jersey, where it is common. It has also been found in the overlying Magothy formation in both New Jersey and Maryland and in the Tuscaloosa formation of Alabama. In the absence of complete and well-marked specimens it is often difficult to differentiate it from contemporaneous species of other genera with similar lanceolate leaves.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

Genus SASSAFRAS Nees

[Hand. Bot., vol. ii, 1831, p. 418]

SASSAFRAS ACUTILOBUM Lesquereux

Plates LXXII; LXXIII; LXXIV, Figs. 1, 2; LXXV, Fig. 2

Sassafras acutilobum Lesquereux, 1874, Cret. Fl., p. 79, pl. xiv, figs. 1, 2.

Sassafras acutilobum Lesquereux, 1883, Cret. and Tert. Fl., p. 56, pl. v, figs. 1, 5.

Sassafras acutilobum Velenovsky, 1884, Fl. Böhm Kreidef., Thiel iii, p. 2, pl. ii, fig. 1.

Sassafras acutilobum Lesquereux, 1892, Fl. Dakota Group, p. 100.

Sassafras acutilobun Hollick, 1893, Trans. N. Y. Acad. Sci., vol. xii, p. 236, pl. vii, fig. 1.

Sassafras acutilobum Newberry, 1896, Fl. Amboy Clays, p. 87, pl. xxv, figs. 1-10; pl. xxvi, figs. 2-6.

Sassafras acutilobum Frič and Bayer, 1901, Archiv. Naturw. Landes, Böhm. Bd. xi, Nr. ii, p. 129, tf. 93.

Sassafras acutilobum Kurtz, 1902, Revista Mus. La Plata, vol. x, p. 53.

Sassafras acutilobum Berry, 1902, Bot. Gazette, vol. xxxiv, p. 438.

Sassafras acutilobum Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, pl. 81, pl. xlv, figs. 1, 2.

Sassafras acutilobum Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, pl. i, fig. 6.

Sassafras acutilobum Berry, 1906, Ann. Rept. State Geol. Survey of New Jersey for 1905, p. 139, pl. xxii, figs. 4, 5.

Sassafras acutilobum Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 77, pl. xxx, figs. 8, 9.

Sassafras acutilobum Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 22.

Sassafras acutilobum Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 140, pl. xviii, fig. 2.

Description.—Trilobate leaves, variable in size and outline. Length 2.5 cm. (in young leaves which are preserved at Woodbridge, New Jersey) up to 14 cm., averaging 10 cm. to 12 cm. Width from the tips of the lateral lobes likewise ranging from 1 cm. to 15 cm., averaging about 10 cm. Lobes mostly conical and acute, the middle being usually slightly the broadest and longest. Lateral lobes directed more or less laterally. Base decurrent. The sinuses between the lobes are usually open and rounded, the margins forming an angle of approximately 90°. There is considerable variation, however, in this respect, some of the leaves having comparatively narrow sinuses with the lobes directed upward, as in *Sassafras progenitor* Hollick, while others at the opposite extreme of the series have extremely shallow sinuses, so shallow that the leaf has the appearance of a triangularly pointed, entire leaf. The lateral primaries may branch from the midrib at or near the base, as they do in a majority of the Raritan forms, or their point of divergence may be a considerable distance above the base, as in modern *Sassafras* leaves. Their angle of divergence from the midrib varies from about 30° to 40°. The secondaries are usually numerous, regular, camptodrome, and connected by transverse tertiaries, although in the Raritan leaves this uniformity is often lacking. Petiole stout and long. The margin vein along the sinus, a marked feature in modern leaves of this genus, is generally wanting in this species, although present in occasional specimens.

This species is apparently widely distributed and almost as variable as the modern *Sassafras*. Described originally from the Dakota group as a variety of *Sassafras mudgei,* it occurs also on Marthas Vineyard and Long Island and in the Raritan and Magothy formations of New Jersey and Delaware. It has been recorded from Cerro Guido, Argentina, and Vele-

novsky identifies somewhat doubtful remains from the Cenomanian of Bohemia as this species. Probable *Sassafras* fruit has been found in the same strata with *S. acutilobum*,[1] tending to show that it is a true *Sassafras*, notwithstanding its dissimilarities; however, this is not certain, as the leaves and fruits were not found associated.

There is considerable doubt as to whether or not these Coastal Plain leaves are generically related to *Sassafras*. Whether the Dakota group forms are those of *Sassafras* it is not easy to decide. No modern *Sassafras* leaves have the primaries and the lateral lobes so nearly horizontal; the secondaries are not so uniformly regular, nor do they curve upward to join the next above at a point. In the modern leaf an outwardly and downwardly directed branch from the latter is emphasized. There is never such an open sinus, amounting as it does to nearly 90°, and the lobes in the modern leaf have their margins inflated and not straight. In these ancient leaves the sinus seldom has a marginal vein, the secondary in this region usually forking and striding it, or curving to join its neighbor. The secondary system seems to be uniform throughout the leaf, while in the modern leaf there is always evidence of changed conditions in that region around the sinus; the secondaries or their representatives from both the primaries and the midrib are changed in size and direction, and usually belong to the tertiary system. None of the Dakota leaves of this species show the characteristic basal venation of the modern leaf. While we should not, necessarily, expect Cretaceous species to conform to the modern type, still the character of the secondary system in the former is so different from what would obtain in a leaf descended from a simple ancestor, such as *Sassafras* is thought to have done, that we are inclined to associate these leaves with those trilobed forms which have been referred to *Aralia* or *Sterculia*, laying aside, for the present, any consideration as to whether or not they are true species of *Aralia* and *Sterculia*.

However, in view of the present uncertainty, and because of the havoc to the stratigraphic value of these leaves which would be wrought by any change of name, they are retained in the genus *Sassafras* pending more positive evidence of their affinity.

[1] Lesquereux, Mon. U. S. Geol. Survey, vol. xvii, p. 230, 1892.

Occurrence.—RARITAN FORMATION. Brightseat, Prince George's County, Maryland; East Washington Heights, District of Columbia. MAGOTHY FORMATION. Grove Point, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

Order MYRTALES

Genus EUCALYPTUS Auct.

EUCALYPTUS ? ATTENUATA Newberry

Eucalyptus ? attenuata Smith, 1894, Geol. Coastal Plain Ala., p. 348 (nomen nudum).

Eucalyptus ? attenuata Ward, 1895, 15th Ann. Rept. U. S. Geol. Survey, p. 371 (nomen nudum).

Eucalyptus ? attenuata Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. iii, pl. xvi, figs. 2, 3 (non fig. 5).

Eucalyptus ? attenuata Berry, 1906, Ann. Rept. State Geol. Survey of New Jersey for 1905, p. 138.

Eucalyptus ? attenuata Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 180.

Eucalyptus ? attenuata Berry, 1907, Ibidem, p. 203.

Eucalyptus ? attenuata Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 195, pl. xxviii, fig. 6.

Description.—Leaves lanceolate in outline, 9 cm. to 12 cm. in length by 1.5 cm. to 2 cm. in greatest width, which is in the basal half of the leaf. Margin entire, somewhat undulate in some specimens. Apex narrow and produced, acutely pointed. Base cuneate. Petiole stout, 1 cm. to 2 cm. in length. Midrib stout, especially in its lower part. Secondaries numerous, branching from the midrib at an acute angle, reticulate-camptodrome.

This species has little in common with the leaves usually referred to this genus, except its outline, which is also that of a great many unallied genera. It is somewhat suggestive of some of the leaves referred to *Laurophyllum,* in fact many possible relationships could be suggested, all of which possess equal elements of uncertainty.

This species is common in the upper Raritan and has a recorded range of considerable extent in somewhat later formations. It is recorded from

the Magothy formation of New Jersey and Maryland, the Black Creek formation of North Carolina, and the Tuscaloosa formation of Alabama.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County; Round Bay, Anne Arundel County.

Collection.—U. S. National Museum.

EUCALYPTUS LATIFOLIA Hollick

Plate LXXXI, Figs. 6, 7

Eucalyptus latifolia **Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 97, pl. xxxv, figs. 1-5.**

Eucalyptus latifolia **Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 26.**

Description.—Leaves elongate-ovate in outline, tapering to a somewhat abruptly attenuated and more or less curved or flexuous tip. Base cuneate. Length about 15 cm. Maximum width, about half-way between the apex and the base, about 5 cm. Midrib stout, flexuous. Secondaries thin, numerous, diverging from the midrib at angles of from 45° to 50°, nearly straight or flexuous, their tops joined by a marginal vein. Margins entire. Texture subcoriaceous.

These large leaves occur in the Magothy formation of Marthas Vineyard, Long Island, and Maryland. They are not uncommon at one locality in the lower Tuscaloosa of Alabama. Their relation to *Eucalyptus* is extremely doubtful, but a change of generic reference is not considered advisable at the present time.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

EUCALYPTUS GEINITZI (Heer) Heer

Plate LXXXI, Figs. 1-5

Myrtophyllum geinitzi **Heer, 1872, Fl. v. Moletein, p. 22, pl. xi, figs. 3, 4.**

Myrtophyllum geinitzi **Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 116, pl. xxxii, figs. 14-17.**

Myrtophyllum geinitzi **Frič, 1878, Archiv. Naturw. Landes, Böhm., Bd. iv, Nr. 1, pp. 18, 94.**

Eucalyptus geinitzi **Heer, 1885, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 93, pl. iv, figs. 1, 13; pl. xix, fig. 1c.**

Eucalyptus geinitzi Engelhardt, 1891, Isis. Ab. vii, p. 102.
Eucalyptus geinitzi Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 138, pl. xxxvii, fig. 20.
Myrtophyllum warderi Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 136, pl. liii, fig. 10.
Eucalyptus ? angustifolia Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi (non Desv. 1822), p. 111, pl. xxxii, figs. 1, 6, 7.
Eucalyptus geinitzi Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 110, pl. xxxii, figs. 2, 12 (non figs. 15, 16).
Eucalyptus geinitzi Krasser, 1896, Beitr. z. Kennt. Kreidef. Kunstadt in Mahren, p. 22.
Eucalyptus geinitzi Hollick, 1898, Ann. N. Y. Acad. Sci., vol. xi, p. 60, pl. iv, figs. 1-3.
Eucalyptus geinitzi Frič and Bayer, 1901, Archiv. Naturw. Landes, Böhm., Bd. xi, Nr. ii, p. 142, tf. 110.
Eucalyptus geinitzi Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 87, pl. liii, fig. 3.
Eucalyptus ? angustifolia Hollick, 1904, Bull. N. Y. Bot. Garden, vol. iii, p. 408, pl. lxx, figs. 8, 9.
Eucalyptus geinitzi Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 78, pl. iv, fig. 5.
Eucalyptus geinitzi Berry, 1906, *Ibidem*, vol. xxxiii, p. 180.
Eucalyptus geinitzi Berry, 1907, *Ibidem*, vol. xxxiv, p. 201, pl. xv, fig. 4.
Eucalyptus ? angustifolia Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 95, pl. xxxv, figs. 9, 14, 15.
Eucalyptus geinitzi Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 96, pl. xxxv, figs. 1-8, 10-12.
Eucalyptus geinitzi Berry, 1907, Johns Hopkins Univ. Circ., n. s., No. 7, p. 81.
Myrtophyllum warderi Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 97, pl. xxxv, fig. 13.
Eucalyptus geinitzi Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 26.
Eucalyptus geinitzi Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 189, pl. xxviii, fig. 7.
Eucalyptus geinitzi Berry, 1912, Bull. Torrey Bot. Club, vol. xxxix, p. 402.
Eucalyptus geinitzi Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 56, pl. xiii, figs. 8-12; pl. xiv, fig. 1.

Description.—Leaves lanceolate in outline, broadest near the middle and tapering almost equally in both directions to the acute apex and base. There is considerable variation in size, averaging about 15 cm. in length by 2.2 cm. in greatest width. The petiole is very stout, as is the prominent midrib, which leaves a sharp groove in impressions showing the lower surface. Secondaries numerous, thin, branching from the midrib at acute angles, about 45°, and running with but a slight curvature to the marginal

vein, which is either almost straight when the secondaries are close set, or more or less bowed when the secondaries are some little distance apart, as is often the case.

This species is especially wide-ranging. It was described originally from the Cenomanian of Moravia and has since been recorded from the Cenomanian of Saxony and the Cenomanian and Turonian of Bohemia, from the Atane beds of Greenland, the Dakota sandstone of the West, and from Marthas Vineyard to Texas along the Atlantic coast. It ranges upward into the Black Creek formation of North Carolina and is not rare in the Middendorf beds of South Carolina. In the Tuscaloosa formation of Alabama the species has not been commonly met with, but this may simply be due to accidents of preservation.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Round Bay and Little Round Bay, Anne Arundel County, Maryland.

Collection.—Maryland Geological Survey.

EUCALYPTUS WARDIANA Berry

Eucalyptus ? dubia Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 87, pl. iii, fig. 1 (non Ettingshausen, 1887).

Eucalyptus wardiana Berry, 1905, Bull. Torrey Bot. Club, vol. xxxii, p. 47.

Eucalyptus wardiana Berry, 1906, *Ibidem*, vol. xxxiii, p. 180.

Eucalyptus wardiana Berry, 1906, Rept. State Geol. of New Jersey for 1905, pp. 138, 139, 141.

Eucalyptus wardiana Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 57, pl. xiv, figs. 3, 4.

Description.—Leaves linear-lanceolate in outline with a pointed base and a gradually narrowed, acuminate tip. Length about 8 cm. to 10 cm. Maximum width about 1.3 cm. Margins entire. Texture subcoriaceous. Midrib of medium size. Secondaries very numerous, equally spaced, at intervals of about 1 mm.; they diverge from the midrib at angles of about 60° and pursue relatively straight courses to the immediate vicinity of the margins where their ends are united by a straight acrodrome marginal vein running close to and parallel with the margins. Tertiaries forming a double series of nearly isodiametric four-sided or five-sided meshes in each interval between adjacent secondaries.

This species greatly resembles some of the smaller forms that have been referred to *Eucalyptus geinitzi,* especially those with closely spaced secondaries. It is, however, quite different from the type of that species, and may be distinguished by its thinner midrib, more numerous secondaries, straighter marginal veins and more prominent tertiaries. It also greatly resembles *Eucalyptus angusta* Velenovsky [1] of the Cenomanian of Bohemia, which species has been recorded by the writer from the upper Raritan of New Jersey and the later Upper Cretaceous in North Carolina and Georgia. It is possible that the two species may be confused since much of the material is fragmentary. *Eucalyptus wardiana* is, however, more elongated, straighter, with more prominent tertiary areolation, and with the secondaries diverging at a wider angle. It characterizes the Magothy formation from Raritan Bay in New Jersey to the Severn River in Maryland, and also occurs in the Middendorf beds of South Carolina.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Round Bay, Anne Arundel County, Maryland.

Collection.—Maryland Geological Survey.

Order UMBELLALES

Family ARALIACEAE

Genus HEDERA Linné

[Sp. Pl., 1753, p. 202]

HEDERA CRETACEA Lesquereux

Hedera cretacea* Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 127, pl. xviii, fig. 1.

Hedera cretacea* Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 180.

Description.—"Leaves subcoriaceous, broadly rhomboidal in outline, obtusely trilobate, subcordiform at base; borders undulate between the lobes, entire downward, nervation palmately five divided from the base; lower primary nerves simple, short and thin, the upper thick, passing up to the point of the lobes, branching on the lower side and forking; secondaries four pairs, opposite, short, equidistant, and parallel with the upper primaries.

[1] Velenovsky, Fl. Böhm. Kreidef., Theil iv, p. 3, pl. iii, figs. 2-12, 1885.

"The only leaf seen of this species is 7 cm. long, 8.5 cm. broad between the points of the lobes, which are short and obtuse. The lower secondaries are thick, forking at the apex and becoming effaced before reaching the borders, being, however, apparently camptodrome like the branches of the primaries."—Lesquereux, 1892.

The present material is fragmentary and not certainly determined as this species, although it is apparently distinct from the allied *Hedera cecilensis* Berry.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

HEDERA CECILENSIS Berry

Plate LXXVIII, Figs. 1, 2

Hedera cecilensis Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 28, pl. viii, fig. 2.

Description.—Leaves of medium size, orbicular in general outline with a tendency toward trilobation, 6 cm. to 7 cm. in length by about 6 cm. in greatest width. Margin entire, with shallow undulate lobes. Petiole and midrib stout. Lateral primaries suprabasilar, not differentiated from the secondaries in some specimens. Secondaries one pair below the lateral primaries and one or two remote pairs above, forking dichotomously and craspedodrome in habit.

This species resembles in a general way several which Lesquereux referred to the genus *Cissites*, as for example, *Cissites harkerianus* and *Cissites acuminatus*. In appearance it suggests the somewhat larger Dakota group leaf which Lesquereux christened *Platanus cissoides*. It is closely related to *Hedera cretacea* Lesqureux, differing in the suprabasilar primaries and in the details of the general outline.

Hedera cecilensis is a very well marked species and is evidently allied to *Hedera*, clearly differentiated, however, from any of the previously described forms. The genus is rather prominent in Upper Cretaceous floras, both in Europe and America, the present species and *Hedera cretacea* Lesquereux resembling closely the existing species. The present

material is from the upper Magothy at Grove Point in Cecil County, from which it takes its name.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—U. S. National Museum.

Genus ARALIA Linné

[Sp. Pl., 1753, p. 273]

ARALIA GROENLANDICA Heer

Aralia groenlandica Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 84, pl. xxxviii, fig. 3; pl. xxxix, fig. 1; pl. xlvi, figs. 16, 17.

Aralia groenlandica Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 134, pl. liv, figs. 1-3.

Aralia groenlandica Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 116, pl. xxviii, fig. 4.

Aralia groenlandica Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 94, pl. xlv, fig. 4.

Aralia groenlandica Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 98, pl. xxxvii, figs. 3-6.

Aralia groenlandica Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 199.

Aralia groenlandica Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 408.

Description.—" A. foliis magnis, coriaceis, lævigatis, basi rotundatis, lobis subæqualibus, lobo medio sinu lato, rotundato, separato."—Heer, 1882.

This species is very poorly defined, both Heer and Lesquereux including in it leaves showing a quite considerable range of variability. They are all coriaceous, trilobate leaves of considerable size with long and short petioles. Length 6 cm. to 10 cm. Width 7 cm. to 12 cm. Lobes ovate, pointed or rounded, with open rounded sinuses, the lateral lobes showing a tendency to become sublobate below. Primaries slender, camptodrome. Lesquereux makes " five nerved from the top of the petiole," a character of this species as it is in all the specimens which he figures and in one or two of Heer's figures. These extra laterals are much more slender than are the regular primaries and are not constant unless the species be considered composite.

The Coastal Plain leaves referred to this species by Newberry, Hollick, and the writer are as a rule somewhat smaller in size, with narrower lobes. This species is infrequent in the Raritan, and the leaves referred

to it are suggestive of what Newberry called *Aralia patens*. The species is more abundant in the somewhat later Cretaceous deposits of Marthas Vineyard, Cliffwood Bluff, and Sullivan's Cove. It was described originally from the Atane beds of Greenland and is also present in considerable abundance in the Dakota group of Kansas.

Occurrence.—MAGOTHY FORMATION. Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

ARALIA RAVNIANA Heer

Plate LXXXII, Fig. 4; Plate LXXXIII, Figs. 1-4

Aralia ravniana **Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 84, pl. xxxviii, figs. 1, 2.**
Aralia greenlandica **Heer, 1882,** *Ibidem*, **pl. xlvi, fig. 17.**
Aralia ravniana **Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 92, pl. xliv, fig. 7; pl. liii, fig. 2; pl. lvii, fig. 1.**
Aralia ravniana **Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 79.**
Aralia ravniana **Berry, 1910,** *Ibidem*, **vol. xxxvii, p. 27.**

Description.—" A. foliis amplis, coriaceis, lævigatis, quinquelobis, lobis integerrimis, lobo medio maximo, basi valde contracto, ovali, lobis lateralibus oblongo-lanceolatis."—Heer, 1882.

This most striking species of *Aralia,* because of its large size, has always been found in a fragmentary condition. Specimens showing all parts of the leaf have now been collected, the Maryland material conclusively confirming the restoration of this leaf made by the writer in 1903 (*op. cit.*). It also confirms the supposition made from the venation of the New Jersey material, that instead of a broadly ovate median lobe, as Heer supposed, this middle lobe was sublobate by the greater or less development of a lateral lobe on each side, as shown in the accompanying restoration based on the Maryland material. The species may be more fully defined in the light of all of the material as follows: Leaves of large size, ranging from 16 cm. to 21 cm. in length and from 19 cm. to 23 cm. in maximum width, orbicular in general outline, deeply pinnate-lobate. Apex of the terminal and lateral lobes bluntly pointed. Base broadly cuneate. Margins entire. Texture subcoriaceous. Lobes usually seven in

number, separated by relatively narrow ultimately rounded sinuses, comprising an ovate medium terminal lobe and two main lateral lobes on either side, the lower pair being more or less divided. In the Maryland material the auxiliary lobe on the lower side of each main lateral lobe is feebly developed. In the Greenland material it is at least half as large as the main lobe and the separating sinus extends half-way to the base. Petiole stout, its full length unknown. Midrib very stout and prominent, straight. Lateral primaries two on each side, stout and prominent, the lower pair subopposite and suprabasilar, the upper pair sometimes subopposite, oftener separated by a wide interval. The lower primary may fork a short distance above its base, as it does in the Greenland material after an interval of only about 1 cm., or this fork may be at least 4 cm. above the base as in the Maryland material, the distance depending on the extent to which the auxiliary lobe is developed. The angle of divergence of the primaries from the midrib is about 40°, but varies from specimen to specimen, the basal pair in general being somewhat more divergent than the upper pair. The secondary and tertiary venation is usually obsolete. Some specimens show a few thin remote secondaries diverging from the primaries at angles of about 45° and sweeping upward in ascending camptodrome curves.

This species was described by Heer from the Greenland Upper Cretaceous (Atane beds) and has been found by the writer in the Magothy formation of both New Jersey and Maryland. The fragments from Marthas Vineyard, Massachusetts, and Tottenville, New York, identified as this species by Hollick,[1] are not this species in the writer's judgment. There is a great display of Aralia-like forms in the Middle Cretaceous both of this country and Europe, and these forms are especially abundant in the Dakota sandstone of the West. Among this diverse display of forms *Aralia ravniana* is approached in both size and outline by *Aralia towneri* Lesquereux of the Dakota sandstone, which is to be regarded as a closely related geographical mutant. Comparisons with existing plants are not so satisfactory, although many tropical *Araliaceæ* show suggestive resem-

[1] Hollick, Mon. U. S. Geol. Survey, vol. l, p. 99, pl. xxxvii, figs. 1, 2, 1907.

blances. The *Moraceæ* in the genus *Artocarpus* and its allies also show many features of this fossil species.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

ARALIA WASHINGTONIANA Berry

Plate LXXXII, Fig. 3

Aralia washingtoniana **Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 27, pl. viii, fig. 4.**

Description.—Leaves of medium size, broadly trilobate, about 9 cm. to 10 cm. in length by 8 cm. in greatest width. Sinuses shallow and rounded. Lobes broadly rounded. Petiole and midrib stout. Lateral primaries scarcely to be distinguished from the secondaries. Secondaries four or five subopposite pairs, rather straight, indifferently camptodrome or craspedodrome. Tertiaries well marked, transverse. Margins entire.

The remains of this species are numerous but fragmentary. In general outline and venation they suggest a species of *Aspidiophyllum,* but they lack the characteristic base of that genus. There is some resemblance, not close, however, to *Aralia rotundiloba* Newberry and to *Aralia nassauensis* Hollick.

Occurrence.—RARITAN FORMATION. East Washington Heights, District of Columbia.

Collection.—U. S. National Museum.

Genus ARALIOPSOIDES n. gen.[1]

ARALIOPSOIDES BREVILOBA Berry

Plate LXXXVI, Fig. 2

Araliopsis breviloba **Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 417.**

Description.—Leaves of medium size, fan-shaped in general outline, between 10 cm. and 11 cm. in length by the same dimensions in maximum

[1] Since proposing the very appropriate name *Araliopsis* (Bull. Torrey Bot. Club, vol. xxxviii, 1911, p. 413) for this genus, the writer has discovered that this name is preoccupied, having been used by Engler in 1895 for a monotypic and little-known genus of *Rutaceæ* from Africa.

width, which is from tip to tip of the lateral lobes. Trilobate. Apical lobe very short and conical. Lateral lobes short and pointed, somewhat recurved outward. Sinuses open, shallow and rounded, not extending more than one-fifth of the distance from the apex to the base. Lateral margins at first full and rounded, then curving inward to the decurrent base. Primaries three in number, equally stout and curved, the laterals subopposite and suprabasilar. Secondaries numerous, curved, camptodrome, branching from the primaries at angles of less than 45°. Tertiaries transverse. Margins entire throughout. Texture coriaceous.

This characteristic leaf is probably the end term of a series of forms starting with *Araliopsoides cretacea,* but whether it represents an extreme of variation of that species or a distinct but related species cannot be definitely determined. The present form suggests various species from the Dakota sandstone of the West, which Professor Lesquereux referred to the genus *Cissites.* It is also similar to the form from the Cenomanian of Bohemia described by Velenovsky[1] as *Aralia anisoloba,* differing slightly in outline and lacking the remotely dentate margins of the latter.

Occurrence.—RARITAN FORMATION. Bull Mountain, Cecil County.

Collection.—Maryland Geological Survey.

ARALIOPSOIDES CRETACEA (Newberry)[2]

Plate LXXIV, Fig. 3; Plate LXXXIV, Figs. 1, 2; Plate LXXXV, Figs. 1-5; Plate LXXXVIII, Figs. 1-3

Sassafras cretaceum Newberry, 1868, Ann. N. Y. Lyc. Nat. Hist., vol. ix, p. 14 (non Penhallow, 1904 and 1908).

Sassafras cretaceum Newberry, 1878, Ills. Cret. and Tert. Pl., pl. vi, figs. 1-4.

Sassafras cretaceum Newberry, 1898, Mon. U. S. Geol. Survey, vol. xxxv, p. 98, pl. vi, figs. 1-4; pl. viii, figs. 1, 2 (non pl. vii, figs. 1-3).

Sassafras cretaceum Lesquereux, 1878, Cret. F., p. 80, pl. xi, figs. 1, 2; pl. xii, fig. 2.

Sassafras cretaceum ? Kurtz, 1902, Revista Mus. La Plata, vol. x.

Sassafras cretaceum Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 22.

Araliopsis cretacea Berry, 1911, *Ibidem*, vol. xxxviii, p. 413.

---

[1] Velenovsky, Fl. Böhm. Kreidef., Theil i, 1882, p. 22, pl. v, figs. 4-6.

[2] This form was cited in 1878 by Saporta and Marion (Mém. Cour. Sav. Etrang. Acad., tome xli, 1878, p. 78), as *Araliopsis (Sassafras) cretacea,* but there is no evidence to show that they had any generic proposal in mind.

Description.—"Leaves petiolate, decurrent at base, very smooth above, strongly nerved below; three-lobed; lobes entire and acute. The nervation is all strongly defined; the central nerve straight or nearly so; the lateral primary nerve springing from it at an angle of 30°; secondary nerves regularly arched till they approach the margin of the lobes, when they are abruptly curved and run together. From these the tertiary nerves are given off at a right angle, and from these the quaternary nerves spring at a similar angle, together forming a network of which the areoles are subquadrate."—Newberry, 1868.

Professor Newberry includes under *Sassafras cretaceum* the various forms described by Professor Lesquereux as *S. mudgei, S. subintegrifolium, S. integrifolium, S. obtusum, S. cretaceum dentatum, S. cretaceum obtusum, S. acutilobum, Cissites harkianus,* and *C. salisburiæfolius.* While this shows the undoubted composite nature of *S. cretaceum,* it also shows that the extremes of leaf form above mentioned are so closely connected with the more typical leaf by a series of intermediate forms that the question of where one species shall end and another begin is an extremely difficult one.

The writer considers the leaf figured by Prof. Newberry on pl. vi, fig. 1, Later Ext. Fl., to be the typical form of this species, thus agreeing with Newberry's original description and with his later opinion expressed in 1898. This type bears considerable resemblance to some modern *Sassafras* leaves. A slight widening of the terminal lobe of some of these in the basal region would give a leaf strikingly like *Araliopsoides cretacea;* or were the sinuses of the latter slightly deeper we would have the typical modern leaf. The basal portion of the leaf is like *Sassafras,* and the indications point to a similar venation in this region. The first pair of secondaries do not branch to form margins of the sinuses; the left one runs directly to the sinus, however, and may possibly have conformed to the margin and been effaced in the specimen; the right one is stronger and runs almost to the sinus where it makes a sharp turn upward, continuing until it joins the next secondary. This feature is analogous to those in the modern leaf, which may indicate the mode of origin of this peculiar character. This leaf seems to form a central figure from which a series of

forms grade in several directions, culminating in quite dissimilar leaves. Lesquereux's *Sassafras cretaceum* is a more planatoid leaf, with more acute tips, a tendency to become dentate, and with the primaries inserted nearer the base. Closely allied to the preceding is his *Sassafras (Araliopsis) mirabile,* which serves as a connecting link with his *Platanus recurvata.* From the aforementioned *Sassafras cretaceum* of Lesquereux it is but a step to such a leaf as the one shown on pl. viii, fig. 2, Later Ext. Fl., and to the trilobed forms referred to *Cissites harkerianus,* and these in turn grade into the more Cissoid forms of this species, such as those shown on pl. ii, fig. 3, Cret. Flora. The primaries are basal and of not much greater caliber than the regularly succeeding straight secondaries. It is but a step from this leaf to that of *Cissites heerii* on the one hand, with its palmately five-pointed blade, and to such forms as *Cissites acuminatus* on pl. v, fig. 4, Cret. and Tert. Fl., on the other; which in turn, by the elimination of the decreasing dentate points, gives us the leaf shown on pl. v, fig. 3, Cret. and Tert. Fl. In the second series of leaves diverging from the typical *Sassafras cretaceum,* pl. viii, fig. 1, Later Ext. Fl., is removed a slight distance by the shortening of the blade, the thickening of the primaries and secondaries, and the shortening and rounding of the lobes (*Sassafras obtusum*); while a smaller leaf would be its logical descendant; and from these leaves to those referred to the typical *Cissites salisburiæfolius* is but a step. In the third series of leaves diverging from the typical *Sassafras cretaceum,* we note that the leaf has its lobes much produced, narrow and running to a sharp point, as in the beautiful leaf on pl. vii, fig. 1, Later Ext. Fl., which, however, is still referred to *Sassafras cretaceum.* Lesquereux's *Sassafras acutilobum* does not differ greatly from the preceding except in the direction of the lobes, which is a questionable specific character. From this leaf it is no great jump to those trilobed forms which are referred to *Aralia wellingtoniana,* the chief difference being in the margin. Thus we have an interrelated series connecting those leaves which seem to show affinity to *Sassafras* with those which suggest *Platanus* on the one hand, and with others which suggest *Cissites* and *Aralia* on the other.

While it may be considered probable that from a biologic viewpoint the forms mentioned in the foregoing paragraphs, as well as others not cited, represent the variations of a single species of Upper Cretaceous tree, or at least represent the leaves of closely filiated species, it seems best from the viewpoint of systematic, and especially stratigraphic, paleobotany, that most of the differentiations instituted by Lesquereux be perpetuated. Consequently the present series is limited to the typical material as defined and illustrated by the original describer.

Falling within these limits are a number of unrecorded occurrences from the Raritan formation of Maryland.

Occurrence.—RARITAN FORMATION. Bull Mountain and Shannon Hill, Cecil County; Brightseat, Prince George's County; Glymont, Charles County, Maryland; East Washington Heights, Overlook Inn Road, District of Columbia.

Collections.—Maryland Geological Survey, U. S. National Museum.

ARALIOPSOIDES CRETACEA DENTATA (Lesquereux) Berry

Plate LXXXVII, Fig. 1

Sassafras (Araliopsis) cretaceum dentatum Lesquereux, 1846, Ann. Rept. U. S. Geol. and Grogr. Survey Terr. for 1874, p. 344.

Sassafras (Araliopsis) cretaceum Lesquereux, 1874, Cret. Fl., p. 80 (pars), pl. xi, figs. 1, 2.

Araliopsis cretacea dentata Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 416.

Description.—Leaves of small or medium size, trilobate in general outline, with cuneate or decurrent base, and acuminate tips. Length ranging from 6 cm. to 11 cm. Maximum width, at a point about midway between the apex and the base, ranging from 5 cm. to 10.5 cm. Sinuses separating the broad and rapidly narrowed lobes, open and rounded, not reaching half-way to the base. Margins entire below, more or less dentate above. Teeth not prominent, widely and irregularly spaced, separated by very shallow sinuses. Petiole stout, enlarged at the base, about 3 cm. in length. Midrib stout and prominent. Lateral primaries, one on each side running to the tips of the lateral lobes, stout, prominent, diverging from the midrib at acute angles (45° or less) above its base, slightly curved outward

in their course. Secondaries relatively stout, numerous, subparallel, camptodrome in those parts of the leaves where the margin is entire, a lesser or greater number craspedodrome in leaves or parts of leaves where the margin is dentate.

This species was described by Lesquereux from the Dakota sandstone as a form of *Sassafras*. It may be distinguished from the type by its usually smaller size and its more or less toothed margin. It is not common and may not be entitled to even varietal rank.

Occurrence.—RARITAN FORMATION. Bull Mountain, Cecil County.

Collection.—Maryland Geological Survey.

ARALIOPSOIDES CRETACEA SALISBURIÆFOLIA (Lesquereux) Berry

Plate LXXXVI, Fig. 1; Plate LXXXVII, Figs. 2, 3

Populites salisburiæfolia Lesquereux, 1868, Amer. Jour. Sci. (ii), vol. xlvi, p. 94.

Sassafras obtusus Lesquereux, 1872, 5th Ann. Rept. U. S. Geol. Survey Terr. (Hayden), 1871, p. 303.

Sassafras obtusus Lesquereux, 1873, 6th Ann. Rept. U. S. Geol. Survey, Terr. (Hayden), 1872, p. 424.

Sassafras obtusum Lesquereux, 1874, Cret. Fl., p. 81, pl. xiii, figs. 2-4.

Sassafras (Araliopsis) cretaceum obtusum Lesquereux, 1874, Cret. Fl., p. 80, pl. xii, fig. 3; pl. xiii, fig. 1.

Cissites obtusum Lesquereux, 1876, 8th Ann. Rept. U. S. Geol. Survey Terr. (Hayden), 1874, p. 354.

Sassafras (Araliopsis) obtusum Lesquereux, 1883, Cret. and Tert. Fl., p. 56.

Cissites salisburiæfolius Lesquereux, 1883, Cret. and Tert. Fl., p. 66.

Cissites salisburiæfolius Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 164.

? *Sassafras cretaceum* Newberry, 1898, Mon. U. S. Geol. Survey, vol. xxxv, pl. viii, fig. 1.

Cissites salisburiæfolius Ward, 1899, 19th Ann. Rept. U. S. Geol. Survey, pt. ii, p. 707, pl. clxxi, fig. 5.

Araliopsis cretacea salisburiæfolia Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 416.

Description.—Leaves of variable size; trilobate in general outline; with a decurrent base; and broad, usually but slightly developed, rounded lobes. Length ranging from 7 cm. to 13 cm. Maximum width, about midway between the apex and the base, ranging from 6 cm. to 15 cm. Margins entire. Texture subcoriaceous. Lobes usually wider than long, separated

by open, usually shallow, rounded sinuses. Petiole very stout, at least 4 cm. or 5 cm. in length. Midrib stout, prominent. Lateral primaries subopposite, suprabasilar, diverging from the midrib at acute angles, stout, prominent, craspedodrome. Secondaries numerous, stout, in general regularly spaced and subparallel, camptodrome.

This well marked variety was described originally from the Dakota sandstone where it is not uncommon. It has been referred successively to the genera *Populites, Sassafras,* and *Cissites,* but is a well marked form of *Araliopsoides* close to *Araliopsoides cretacea.*

Occurrence.—RARITAN FORMATION. Bull Mountain, Cecil County.

Collection.—Maryland Geological Survey.

Family CORNACEAE

Genus CORNUS Linné

[Sp. Pl., 1753, p. 117]

CORNUS CECILENSIS Berry

Plate LXXXII, Fig. 2

Cornus cecilensis Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 408, pl. xix, fig. 4.

Description.—Leaves of medium size, broadly ovate or elongate-elliptical in general outline, 8.5 cm. in length by 4.75 cm. in maximum width, at a point about half-way between the apex and the base. Apex bluntly pointed. Base cuneate. Midrib stout. Secondaries about six pairs, branching from the midrib at an angle of about 45°, curving upward approximately parallel with the lateral margins, at length camptodrome. Tertiaries obsolete. Texture subcoriaceous.

Several Cretaceous forms have been referred to the genus *Cornus,* although this determination is not conclusively proven. Leaves of a similar facies are found among the *Rhamnales,* representatives of which order would be much more likely to occur under the climatic conditions of the Upper Cretaceous than would those of *Cornus.*

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

CORNUS FORCHHAMMERI Heer

Plate LXXXII, Fig. 1

Cornus forchhammeri Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 85, pl. xliv, fig. 13.

Cornus forchhammeri Berry, 1910, Bull. Torrey Bot. Club, vol. xxxviii.

Description.—" C. foliis herbaceis, ellipticis, integerrimis, nervo medio valido, nervis secundariis utrinque 4, oppositis, subtilibus, angulo acuto egredientibus, distantibus, curvatis, camptodromis."—Heer, 1882.

The Grove Point leaf is a trifle narrower than the type, otherwise the two are identical. *Cornophyllum vetustum* Newberry[1] from the Raritan formation of New Jersey is possibly the same species. The features in which the Maryland leaf differs from that of Newberry are its more lanceolate form; the symmetrical base; the fewer secondaries (four to six, instead of six to seven), which form a much more acute angle with the midrib, and are more regular in their course; the presence of the transverse tertiaries, which are not visible in the Raritan leaf. The Grove Point leaf has a more regular margin, a longer petiole, a stouter midrib and a more secondary venation, all features in which the New Jersey leaf departs somewhat from the typical leaves of *Cornus*.

The present species was described from the Atane beds of Greenland to which it is confined except for its occurrence in the Magothy formation of Maryland. The generic reference is not positive and it may well be questioned if this and allied forms that are commonly referred to *Cornus* are not more properly referable to the *Rhamnaceæ*.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—U. S. National Museum.

Order ERICALES

Family ERICACEAE

Genus ANDROMEDA Auct.

ANDROMEDA NOVÆ-CÆSAREÆ Hollick

Plate LXXXIX, Figs. 1, 2

Andromeda novæ-cæsareæ Hollick, 1896, in Newberry, Mon. U. S. Geol. Survey, vol. xxvi, p. 121, pl. xlii, figs. 9-12, 28-31.

Andromeda novæ-cæsareæ Smith, 1894, Geol. Coastal Plain in Ala., p. 348.

[1] Newberry, Mon. U. S. Geol. Survey, vol. xxvi, p. 119, pl. xix, fig. 10, 1896.

Andromeda novæ-cæsareæ Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 181.

Andromeda novæ-cæsareæ Berry, 1907, *Ibidem*, vol. xxxiv, p. 29, vol. xxxvii, p. 29.

Andromeda novæ-cæsareæ Berry, 1911, Bull. 3, Geol. Survey of New Jersey, pl. xx, fig. 7.

Andromeda novæ-cæsareæ Berry, 1912, *Ibidem*, vol. xxxix, p. 405.

Andromeda novæ-cæsareæ Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, pp. 58, 120, pl. xiv, figs. 5, 6; pl. xxiv, fig. 1.

Description.—Leaves small, thick, and entire, with stout petioles and midribs and obscure secondary venation which is immersed in the thick lamina. Length 2.5 cm. to 5 cm. Width varying from 0.9 cm. to 1.3 cm. Venation, where visible, showing numerous parallel, camptodrome, relatively long and thin secondaries which branch from the midrib at acute angles. While the majority of these leaves are equally acuminate at both ends, there is considerable variation in this respect, and a well-marked tendency is shown in a considerable number of specimens which are relatively broader, especially in the upper half, toward an obtusely rounded apex, the termination of the midrib showing as a small mucronate point. The base in these forms gradually narrows to the stout petiole. The variations in outline of this species are well shown in the figures reproduced in Professor Newberry's monograph, the specimens collected from the South Atlantic Coastal Plain having an obtusely rounded apex seemingly more often than those from New Jersey.

In the Raritan formation this species is only known with certainty from the uppermost beds at South Amboy, New Jersey. It becomes more abundant in the overlying Magothy formation, occurring from New Jersey to Maryland in beds of this age. Farther south it is found as one of the typical fossils of the Black Creek formation in North Carolina, being a prominent but never abundant element in the dark lignitic laminated clays of the upper beds associated with *Araucaria, Cunninghamites, Pistia,* etc., and a marine fauna.

It occurs in the Middendorf beds of South Carolina and is also present in Georgia and the Woodbine formation of northeastern Texas. It has not been observed to be common in the Tuscaloosa formation, being only

known from near the base. However, the abundance of this species at somewhat higher horizons in Georgia would indicate that its rarity in the Tuscaloosa deposits may be more apparent than real.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County; Round Bay, Ann Arundel County.

Collection.—Maryland Geological Survey.

ANDROMEDA COOKII Berry

Plate LXXXIX, Fig. 3

Andromeda flexuosa Newberry, 1896, Mon. U. S. Survey, vol. xxvi, p. 121, pl. xxxiv, figs. 1-5 (non Moon 1849).

Andromeda flexuosa Hollick, 1904, Bull. N. Y. Bot. Garden, vol. iii, p. 416, pl. lxxix, fig. 2.

Andromeda flexuosa Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 101, pl. xxxix, fig. 6.

Andromeda cookii Berry, 1909, Bull. Torrey Bot. Club, vol. xxxvi, p. 261.

Andromeda cookii Berry, 1910, *Ibidem*, vol. xxxvii, p. 29.

Andromeda cookii Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 206, pl. xxvi, figs. 3, 4.

Description.—Leaves of variable size, narrowly lanceolate and often falcate in general outline, with an acuminate apex and a cuneate base. Length ranging from 6 cm. to 12 cm. in the middle part of the leaf. Margins entire. Texture coriaceous. Midrib stout and flexuous. Secondaries strong, somewhat flexuous, branching from the midrib at acute angles and arching upward in ascending camptodrome curves. Tertiaries mostly simple, transverse, forming oblong areoles.

This species is of the same general character as the other Cretaceous species of *Andromeda,* with which it is strictly congeneric. It makes its earliest appearance in the lower Raritan of New Jersey, where it is common. It is not uncommon in the overlying Magothy formation.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County; Round Bay, Anne Arundel County.

Collection.—Maryland Geological Survey.

ANDROMEDA PARLATORII Heer

Plate LXXXIX, Fig. 4

Andromeda parlatorii Heer, 1866, Phyll. Crét. d. Nebr., p. 18, pl. i, fig. 5.
Prunus ? parlatorii Lesquereux, 1868, Amer. Jour. Sci., vol. xxxvi, p. 102.
Andromeda parlatorii Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 112, pl. xxxii, figs. 1, 2.
Andromeda parlatorii Heer, 1882, *Ibidem*, Bd. vi, Ab. ii, p. 79, pl. xxi, figs. 1b, 11; pl. xlii, fig. 4c.
Andromeda parlatorii Lesquereux, 1874, Cret. Fl., p. 88, pl. xxiii, figs. 6, 7; pl. xxviii, fig. 15.
Andromeda parlatorii Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 115, pl. xix, fig. 1; pl. xlii, fig. 6.
Andromeda parlatorii Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 120, pl. xxxi, figs. 1-7; pl. xxxiii, figs. 1, 2, 4, 5.
Andromeda parlatorii Smith, 1894, Geol. Coastal Plain in Ala., p. 348.
Andromeda parlatorii Hollick, 1898, Ann. N. Y. Acad. Sci., vol. xi, p. 420, pl. xxxvii, figs. 1-4.
Andromeda parlatorii Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 101, pl. xxxix, figs. 2-5.
Andromeda parlatorii Berry, 1903, Bull. N. Y. Bot. Garden, vol. iii, p. 97, pl. i, figs. 1-4.
Andromeda parlatorii Berry, 1904, Bull. Torrey Bot. Club, vol. xxxi, p. 79, pl. i, figs. 1, 2.
Andromeda parlatorii Berry, 1906, *Ibidem*, vol. xxxiii, p. 181.
Andromeda parlatorii Berry, 1907, *Ibidem*, vol. xxxiv, p. 203, pl. xv, fig. 2.
Andromeda parlatorii Berry, 1907, Johns Hopkins Univ. Circ., n. s., No. 7, p. 81.
Leucothoe parlatorii Schimper, 1874, Pal. Végét., vol. iii, p. 11.
Andromeda parlatorii Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 29.
Andromeda parlatorii Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 206, pl. xxvii, figs. 1-4.
Andromeda parlatorii Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 60.

Description.—Leaves ovate-lanceolate in outline, with a long and gradually narrowed apex, and a broad, somewhat rounded, but finally cuneate or slightly decurrent base. Petiole and midrib stout. Length about 10 cm. to 12 cm. Maximum width about 3 cm. in the lower half of the leaf. Secondaries numerous, rather thin, subparallel, branching from the midrib at acute angles, long and ascending, at length camptodrome. Tertiaries mostly straight, transverse. There is considerable variation in the size of these leaves and in the angle which the secondaries form with the midrib, and consequently in their length and degree of curvature. Some

of the specimens approach quite closely to the small leaves of *Andromeda grandifolia* Berry, which are more slender and apically attenuated than in the normal sized leaves of the latter.

This species was first described by Professor Heer in one of the earliest published accounts of the Dakota group flora, and it has since been found to have a wide geographical range. It is one of the commonest fossils in the Dakota sandstone, having been recorded from Minnesota, Kansas, and Nebraska. In eastern North America it is recorded from the Atane beds of Greenland, the Magothy formation on Marthas Vineyard, the Raritan formation of New Jersey, the Magothy formation of New Jersey, Delaware, and Maryland, the Black Creek formation of North Carolina, and the Middendorf beds of South Carolina. In Alabama it is common in the Tuscaloosa formation and extends into the lower Eutaw beds in Hale County.

The genus *Andromeda* of Linné has been much segregated by the subsequent taxonomists, and this is reflected in Schimper's proposal to refer this species to the genus *Leucothoe*. However, the more comprehensive name has obvious advantages for the paleobotanist in cases like this, where it is impossible to discriminate between the various Ericaceous genera with any degree of accuracy.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County; Round Bay, Anne Arundel County, Maryland.

Collection.—Maryland Geological Survey.

ANDROMEDA GRANDIFOLIA Berry

Andromeda latifolia Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 120, pl. xxxiii, figs. 6-8, 10 (non fig. 9); pl. xxxiv, figs. 6-11; pl. xxxvi, fig. 10 (non Wright).

Andromeda latifolia Smith, 1894, Geol. Coastal Plain in Ala., p. 348 *(nomen nudum)*.

Andromeda latifolia Hollick, 1904, Bull. N. Y. Bot. Garden, vol. iii, p. 416, pl. lxxix, fig. 3.

Andromeda latifolia Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 100, pl. xxxix, fig. 1.

Andromeda grandifolia Berry, 1907, Bull. Torrey Bot. Club, vol. xxxiv, p. 204, pl. xv, fig. 3.

Andromeda grandifolia Berry, 1910, *Ibidem*, vol. xxxvii, p. 28.

Andromeda grandifolia Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 205, pl. xxvi, figs. 1, 2.

Andromeda grandifolia Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 59, pl. xiv, fig. 10.

Description.—Leaves thick and coriaceous, varying considerably in size and shape. From 4 cm. to 20 cm. in length by 1.5 cm. to 7 cm. in width. Ovate-lanceolate in outline with an entire, usually somewhat undulate or unsymmetrical margin. Apex obtusely pointed or sometimes rounded. Base somewhat wedge-shaped. Midrib and petiole very stout. Secondaries relatively few, six to eight pairs, stout and flexuous, branching from the midrib at acute angles and sweeping upward in long curves, eventually inosculating to complete the strictly camptodrome venation.

This species occurs from the lower Raritan of New Jersey to the top of the eastern leaf-bearing Cretaceous. It is a not uncommon fossil in the Magothy formation from New Jersey to Maryland, the Black Creek beds of North Carolina, and the Tuscaloosa formation of Alabama. It is larger, relatively broader, and less regular than *Andromeda parlatorii* Heer.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

Order PRIMULALES

Family MYRSINACEAE

Genus MYRSINE Linné

[Sp. Pl., 1753, p. 196]

MYRSINE BOREALIS Heer

Plate LXXXIX, Fig. 5

Myrsine borealis Heer, 1874, Fl. Foss. Arct., Bd. iii, Ab. ii, p. 113, pl. xxxii, fig. 23.

Myrsine borealis Heer, 1882, *Ibidem*, Bd. vi, Ab. ii, p. 81, pl. xxiv, figs. 7b, 8; pl. xxvii, fig. 1b; pl. xliv, fig. 5a; pl. xlvi, figs. 19, 20.

Myrsine borealis White, 1890, Amer. Jour. Sci., vol. xxxix, p. 98, pl. ii, fig. 5.

Myrsine borealis Smith, 1894, Geol. Coastal Plain Ala., p. 348.

Myrsine borealis Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 122, pl. xxiv, figs. 4-6.

Myrsine borealis Hollick, 1895, Bull. Geol. Soc. Amer., vol. vii, p. 13.

Myrsine borealis Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 102, pl. xxxix, figs. 10, 11.

Diospyros rotundifolia Hollick, 1894, Bull. Torrey Bot. Club, vol. xxi, p. 53, pl. clxxix, fig. 2.
Myrsine borealis Berry, 1910, Bull. Torrey Bot. Club, vol. xxxvii, p. 29.
Myrsine borealis Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 208.

Description.—" M. foliis ovatis (?), integerrimis, nervis secundariis numerosis, approximatis, ramosis, camptodromis."—Heer, 1874.

Leaves ovate-elliptical in outline, obtusely rounded above and slightly cuneate below, 2.5 cm. to 5 cm. in length by 1.2 cm. to 3 cm. in maximum width, with a stout petiole about 1 cm. in length. Margins entire. Texture coriaceous, more or less obscuring the venation. Midrib stout. Secondaries mediumly stout, five to eight alternate pairs, parallel, branching from the midrib at acute angles, camptodrome. Tertiaries fine, forming an inosculating series of elongated meshes, more or less parallel with the secondaries. In specimens in which the tertiary venation is visible the appearance is very different from that shown in Professor Newberry's figures where only the secondaries are seen. These latter may be compared with the similarly preserved leaves from Greenland figured by Heer (pl. xxiv, fig. 8; pl. xliv, fig. 5a).

This species was described originally from the Atane beds of Greenland by Professor Heer, and was subsequently collected in considerable abundance from the Raritan formation in New Jersey. It has also been recorded from Marthas Vineyard and Long Island, and from the Black Creek formation in North Carolina. In Alabama it is, so far as known, confined to the Lower Tuscaloosa of Fayette County, where it is not especially common.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collections.—Maryland Geological Survey, U. S. National Museum.

MYRSINE GAUDINI (Lesquereux) Berry

Plate LXXXIX, Figs. 6, 7

Myrsinites ? gaudini Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 115, pl. lii, fig. 4.
Myrsine elongata Hollick, 1894, Bull. Torrey Bot. Club, vol. xxi, p. 54, pl. clxxvii, fig. 2.
Myrsine elongata Hollick, 1898, Ann. Rept. N. Y. Acad. Sci., vol. xi, p. 420, pl. xxxviii, figs. 3, 4.

Myrsine elongata Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 102, pl. viii, fig. 1b; pl. xxxix, figs. 13, 14.
Myrsine elongata Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 122, pl. xxii, figs. 1-3.
Myrsine gaudini Berry, 1909, Bull. Torrey Bot. Club, vol. xxxvi, p. 262.
Myrsine gaudini Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 210, pl. xxiv, figs. 3, 4.
Myrsine gaudini Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 408.
Myrsine gaudini Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 61, pl. xiv, fig. 9.

Description.—Leaves oblanceolate or elongate-obovate in outline, 5.5 cm. to 7 cm. in length by 1.9 cm. to 2.5 cm. in greatest width. Margins entire. Apex obtusely rounded. Base somewhat elongated, narrowly cuneate. Petiole present, stout. Midrib stout below, rapidly diminishing in caliber. Secondaries numerous, eight to ten pairs, alternate, branching from the midrib at angles of from 40° to 45°, camptodrome. When tertiary venation is distinctly preserved the venation is more typical of the genus than when only the secondaries are partially visible.

This species is well distributed in the Raritan formation and has been recorded also from Long Island and Staten Island. The identification of *Myrsinites ? gaudini* Lesquereux with the eastern forms with which it is obviously identical extends the range eastward from Kansas to Long Island. It may be readily distinguished from the other species of *Myrsine* by its relatively narrow elongated form. It is present in the Black Creek formation of North Carolina, the Middendorf beds of South Carolina, and the Tuscaloosa formation of Alabama.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

Order EBENALES

Family SAPOTACEAE

Genus SAPOTACITES Ettingshausen

[Abh. k. K. geol. Reichs., Bd. ii, 1853, p. 61]

SAPOTACITES KNOWLTONI Berry

Plate XC, Fig. 2

Sapotacites sp. Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 114, pl. lxv, fig. 3.
Sapotacites Knowltoni Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 181, pl. viii, fig. 1.

Description.—Leaves elliptical in general outline, with a slightly emarginate apex and full rounded margins to the broadly pointed base. Length 5.5 cm. Maximum width, in the middle part of the leaf, about 2.5 cm. Margins entire. Texture subcoriaceous. Petiole stout, curved, about 4 mm. to 5 mm. long, slightly expanded proximad. Midrib stout. Secondaries thin, diverging from the midrib at angles of about 35°, ascending, camptodrome, often obsolete by immersion in the leaf substance. Tertiaries obsolete.

The present well-marked species occurs in the Magothy formation of the East and the Dakota sandstone of the West. It is very similar to *Sapotacites obovata* Velenovsky [1] of the Cenomanian of Bohemia, the latter being a somewhat larger leaf and relatively narrower toward the base. The present species also resembles *Sapotacites retusus* Heer as it occurs in the Raritan formation, but is less emarginate and widest across the middle and not toward the base; the basal lateral margins are convex instead of concave and the secondaries are more ascending.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—Maryland Geological Survey.

Genus BUMELIA Swartz

[Prodr. Veg. Ind. Oc., 1788, p. 49]

BUMELIA PRÆNUNTIA n. sp.

Plate XC, Fig. 1

Description.—Leaves of rather small size, obovate in general outline, with a broadly rounded and sometimes faintly retuse tip, and a narrow pointed base. Length about 4.5 cm. Maximum width, above the middle of the leaf, about 1.8 cm. Margins entire, evenly rounded distad, rather straight or only slightly curved proximad. Texture subcoriaceous. Midrib stout and prominent, usually slightly curved. Secondaries numerous, thin, camptodrome, diverging from the midrib at an angle of about 55°, largely immersed in the leaf substance. Tertiaries obsolete.

This species resembles the form from the Raritan formation of New Jersey described by Newberry as *Dalbergia apiculata*. It is named *præ-*

[1] Velenovsky, Fl. Böhm. Kreidef., Theil iii, p. 3, pl. iii, fig. 6, 1884.

nuntia, since it is prophetic and probably ancestral to *Bumelia lanuginosafolia* Berry of the Wilcox Eocene. It is suggestive of several modern species of *Bumelia* of the coastal region in the southern United States and throughout tropical America to Brazil. There are a score of existing species confined to America.

Occurrence.—MAGOTHY FORMATION. Grove Point, Cecil County.

Collection.—Maryland Geological Survey.

Family EBENACEAE

Genus DIOSPYROS Linné

[Sp. Pl., 1753, p. 1057]

DIOSPYROS PRIMÆVA Heer

Plate XC, Fig. 4

Diospyros primæva Heer, 1866, Phyll. Crét. d. Nebr., p. 19, pl. i, figs. 6, 7.
Diospyros primæva Heer, 1882, Fl. Foss. Arct., Bd. vi, Ab. ii, p. 80, pl. xviii, fig. 11.
Diospyros primæva Heer, 1883, Ibidem, Bd. vii, p. 31, pl. ii, figs. 5a, 5b, 5c.
Diospyros primæva Engelhardt, 1891, Isis, Abh. vii, p. 98.
Diospyros primæva Lesquereux, 1892, Mon. U. S. Geol. Survey, vol. xvii, p. 109, pl. xx, figs. 1-3.
? *Diospyros primæva* Frič, 1893, Archiv. Naturw. Landes. Böhm., Bd. ix, Nr. i, p. 130, tf. 186.
Diospyros primæva Smith, 1894, Geol. Coastal Plain Ala., p. 348.
Diospyros primæva Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 124, pl. xxx, figs. 1-5.
Diospyros primæva Bartsch, 1896, Bull. Lab. Nat. Hist., Univ. Iowa, vol. iii, p. 181.
Diospyros primæva Knowlton, 1901, 21st Ann. Rept. U. S. Geol. Survey, pt. vii, p. 317, pl. xxxix, fig. 3.
Diospyros primæva Berry, 1905, Bull. Torrey Bot. Club, vol. xxxii, p. 46, pl. ii.
Diospyros primæva Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 103, pl. xlii, figs. 2, 11.
Diospyros primæva Berry, 1911, Bull. Torrey Bot. Club, vol. xxxiv, p. 2C4.
Diospyros primæva Berry, 1911, *Ibidem*, vol. xxxviii, p. 417.
Diospyros primæva Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 211, pl. xxix, fig. 1.
Diospyros primæva Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 61, pl. xi, fig. 3; pl. xiv, figs. 12, 13.

Description.—Leaves oblong-ovate in outline, variable according to age, ranging from 3 cm. to 15 cm. in length by 1.3 cm. to 5 cm. in greatest

width, which is in the middle part of the leaf. Apex acute or obtuse. Base cuneate. Margins entire. Petiole rather long and very stout. Midrib also stout. Secondaries branching from the midrib usually at acute angles, subopposite or alternate, parallel, camptodrome. Tertiaries forming polygonal areoles whose relative prominence is one of the features of this species.

This species, which is quite suggestive of the modern *Diospyros virginiana* Linné, was described by Heer from the Dakota group of Nebraska nearly half a century ago. It has proved to be a most wide-ranging form, having been identified at both the Atane and Patoot horizons in Greenland; in the Cenomanian of Saxony and the Turonian of Bohemia; from various localities within the Dakota group, including its southern extension, the Woodbine formation of Texas; and, with the exception of the fragments from Marthas Vineyard and Long Island, which are of questionable identity, it is present, in either the Raritan, or the Magothy, or homotaxial formations, from New Jersey to Alabama.

Its most marked character is the prominence of its tertiary areolation. It is common at various localities in the lower Tuscaloosa of western Alabama and continues upward into those beds in Hale County which have been placed in the basal portion of the Eutaw formation.

Occurrence.—RARITAN FORMATION. Bull Mountain, Cecil County. MAGOTHY FORMATION. Bodkin Point, Anne Arundel County.

Collection.—Maryland Geological Survey.

DIOSPYROS ROTUNDIFOLIA Lesquereux

Plate XC, Fig. 3

Diospyros rotundifolia Lesquereux, 1874, Cret. Fl., p. 89, pl. xxx, fig. 1.

Diospyros rotundifolia Lesquereux, 1892 Mon. U. S. Geol. Survey, vol. xvii, p. 112, pl. xvii, figs. 8-11.

Diospyros rotundifolia Berry, 1906, Ann. Rept. State Geol. of New Jersey for 1905, p. 139.

Diospyros rotundifolia Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 181.

Diospyros rotundifolia Berry, 1914, Prof. Paper U. S. Geol. Survey, No. 84, p. 62, pl. xiv, fig. 14.

Description.—Leaves entire, variable in size, 4 cm. to 10 cm. in length by 2 cm. to 7 cm. in maximum width, which is in the middle part. Outline

broadly oval or elliptical. Apex broadly rounded. Base similarly rounded or somewhat narrowed and pointed. Petiole and midrib stout. Secondaries six or seven pairs, branching from the midrib at angles of from 50° to 60°, arched, camptodrome. Texture subcoriaceous. Venation less prominent than in *Diospyros primæva* Heer.

This species is a characteristic element in the post-Raritan flora of the Atlantic Coastal Plain, although at times it is liable to be confused with *Myrsine borealis* Heer, or with some of the smaller, more orbicular, entire leaves referred to *Populus*. The venation is markedly different, however.

Diospyros rotundifolia was described originally from the Dakota group of Kansas, and it is common in the Magothy formation in New Jersey, Delaware, and Maryland. In South Carolina it has been found only at a single locality in the Middendorf beds. It is not rare in the lower Tuscaloosa of western Alabama.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware; Grove Point, Cecil County, Maryland.

Collection.—Maryland Geological Survey.

DIOSPYROS VERA Berry

Plate XC, Fig. 5

Diospyros vera Berry, 1911, Bull. Torrey Bot. Club, vol. xxxviii, p. 418, pl. xix, fig. 5.

Diospyros vera Berry, 1912, Plant World, vol. xv, p. 17, fig. 2.

Description.—Calyx small, four-parted, 11.5 mm. in diameter from tip to tip of the lobes, which are obtusely pointed and nearly orbicular in outline, about 4 mm. or 5 mm. in width, contracted proximad and somewhat reflexed, coriaceous, longitudinally veined, with inflexed margins which give them a spoon-like form. Sinuses rather narrow and pointed, extending two-thirds of the distance to the peduncle. The central disk of the calyx appears flat. There is a raised collar at the insertion of the peduncle, the latter from its scar appears to have been relatively slender.

The present species is based upon the single specimen figured, which shows the lower, peduncular face of the calyx. It is clearly referable to this genus and was probably accrescent as in the modern forms. It is

much smaller than in our common American *Diospyros virginiana* L., but may be matched in some of the still existing species and is almost the exact counterpart of some of the calices of *Diospyros brachysepala* Al. Br., figured by Heer from the Swiss Tertiary. There can be no question regarding its identity and in this respect it is much more conclusive than the *Calycites diospyriformis* described by Newberry from the middle Raritan of New Jersey, which has a five-lobed calyx. Its occurrence at the same horizon at which the leaves of *Diospyros primæva* Heer are so abundant not only suggests that it may have been borne by the same tree which furnishes the leaves found all the way from western Greenland to Alabama, but also serves in a measure to corroborate the identification of these leaves.

The family *Ebenaceæ* has only five modern genera, but these include a large number of species, a majority of which are referred to the genus *Diospyros*. The latter has about one hundred and eighty existing species distributed in both hemispheres. They are mostly tropical, a few species extending beyond the tropics in eastern North Amedica, in the Mediterranean region of Eurasia, and in eastern Asia where there is a considerable massing of forms.

Occurrence.—RARITAN FORMATION. East Washington Heights, District of Columbia.

Collections.—U. S. National Museum.

Order POLEMONIALES

Family BORAGINACEAE

Genus CORDIA Linné

[Sp. Pl., 1753, p. 190]

CORDIA APICULATA (Hollick) Berry

Plate XC, Fig. 6

Populus apiculata Hollick, 1892, Trans. N. Y. Acad. Sci., vol. xii, p. 4, pl. iii, fig. 2.

Populus apiculata Smith, 1894, Geol. Coastal Plain in Ala., p. 548.

Populus apiculata Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, p. 65, pl. xv, figs. 3, 4.

Populus apiculata Berry, 1906, Bull. Torrey Bot. Club, vol. xxxiii, p. 172.

Populus apiculata **Hollick, 1907, Mon. U. S. Geol. Survey, vol. l, p. 49, pl. vii, figs. 28, 29.**
Populus apiculata **Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 111, pl. xi, fig. 4.**

Description.—Leaves variable in size and shape, ovate to orbicular in general outline, 5 cm. to 10 cm. in length by 3 cm. to 7 cm. in maximum width, which is at or below the middle. Apex usually somewhat abruptly produced into an acuminate tip. Base cuneate and slightly decurrent to rounded or almost truncate. Margins entire, sometimes slightly repand. Petiole of medium length, stout. Midrib mediumly stout, often flexuous. Secondaries five or six pairs, subopposite below, alternate above, slender, branching from the midrib at angles of from 45° to 50° and arching upward, camptodrome. Tertiaries camptodrome in the marginal region, percurrent internally.

Professor Newberry, the original describer of this species in manuscript, compared it with *Populus hyperborea* Heer and *Populus berggreni* Heer, but seemed doubtful of its real relation to *Populus*. This doubt seems to be well founded, for while these leaves are not unlike those usually referred to the genus *Populus*, this assumed relationship has by no means been proven for a number of the Upper Cretaceous forms so identified. While it is not impossible that species of *Populus* may have flourished from New Jersey to the Gulf region during the Upper Cretaceous, the association of a number of forms whose descendants are tropical led to an extended search among existing tropical American forms, with the result that the present species is referred to the genus *Cordia*. The latter has upwards of two hundred existing species of the tropics and warmer extra-tropical regions of both hemispheres, the majority being American, several of which reach the Florida Keys, the Bahamas, and the valley of the Rio Grande. The fossil species in all its characters suggests most strongly the existing *Cordia sebestena* Linné which ranges from the Florida Keys to New Guinea. It also suggests *Cordia tremula* Griesbach of the West Indies, and there is a general generic likeness to various other existing species of this genus. *Cordia* leaves are variable and tend to have more or less toothed margins as is sometimes the case in *Cordia sebestena*, but they

are in general entire or slightly repand, and like the fossil somewhat variable. *Cordia* is certainly represented in the lower Eocene flora of the Gulf region by forms that may be descendants of this Upper Cretaceous species. The present form has been recorded from New Jersey, Staten Island, Long Island, and Delaware, and is not rare in the lower beds of the Tuscaloosa formation in the Alabama region.

Occurrence.—MAGOTHY FORMATION. Deep Cut, Delaware.

Collection.—U. S. National Museum.

DICOTYLEDONAE INCERTAE SEDIS

Genus FONTAINEA Newberry

[Mon. U. S. Geol. Survey, vol. xxvi, 1896, p. 94]

FONTAINEA GRANDIFOLIA Newberry

Fontainea grandifolia Newberry, 1896, Mon. U. S. Geol. Survey, vol. xxvi, 1895, p. 96, pl. xlv, figs. 1-4.

Fontainea grandifolia Berry, 1911, Bull. 3, Geol. Survey of New Jersey, p. 219.

Description.—Species based on relatively large leaves which may be regarded as bilobate or as dichotomously compound with bilobate leaflets. The latter are linear lanceolate and markedly unsymmetrical in outline, being narrowed and obtusely pointed distad and markedly inequilateral proximad, one margin decurring for a distance of from 1 cm. to 2 cm. below the opposite margin. The extremely stout midrib (or common winged petiole of a double leaf) runs straight for a distance of 5 cm. to 6 cm. before forking dichotomously at an acute angle. Internally this fork is often naked for a distance of 2 cm. to 3 cm. Secondaries fine, numerous, subparallel; they diverge from the midrib at wide angles and become more or less lost in the leaf substance toward the margin, their ends apparently united by flatly arched marginal veins. Areolation quadrangular. Margins entire. Texture coriaceous.

The present species was described by Newberry from the middle Raritan of Woodbridge, New Jersey, to which locality it has hitherto been confined. It is obviously dicotyledonous, although the writer knows of no similar existing forms. Among previously described fossil species it is

This species is based on a single remarkably well-preserved specimen washed out of the sandy carbonaceous clays of the Magothy formation. Its botanical relationship is uncertain since a variety of existing genera have comparable fruits. Among these might be mentioned various genera of the *Euphorbiaceæ, Sterculiaceæ, Malvaceæ,* etc. Somewhat similar Eocene fruits have been described by the writer as species of *Sterculiocarpus,* and by Viguier as species of *Sezanella,* both genera being referred to the family *Sterculiaceæ.*

Occurrence.—MAGOTHY FORMATION. Deep Cut, Chesapeake and Delaware Canal, Delaware.

Collection.—Johns Hopkins University.

PLATES

PLATE VIII

PAGE

Figs. 1, 2. Thoracosaurus neocæsariensis (DeKay)................. 347
1. Tooth, side view.
2. Transverse outline of same.
Matawan formation, Magothy River.

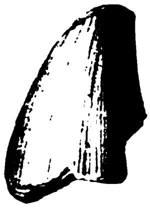
Figs. 3, 4. Hyposaurus rogersii Owen................................ 349
3. Tooth, side view.
4. Transverse outline of same.
Monmouth formation, Bohemia Mills.

Figs. 5-7. Lamna elegans Agassiz.................................. 350
5. Front view of a worn tooth. × 1.
6. Inside view of another specimen. × 2.
7. Side view of a third specimen. × 2.
Monmouth formation, Seat Pleasant.

Figs. 8, 9. Lamna cuspidata Agassiz................................ 351
8. Inside view. × 1. Matawan formation, C. & D. Canal.
9. Inside view of a small specimen. × 2. Monmouth formation, Brooks' Estate near Seat Pleasant.

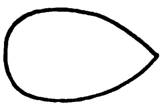
Fig. 10. Side view of proximal part of a fish spine. × 3. Matawan formation, C. & D. Canal.

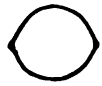
Fig. 11. Thoracosaurus sp... 348
Much worn vertebra, ventral view. Monmouth formation, Prince George's County.

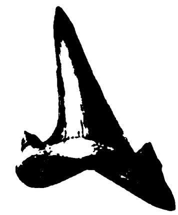

1

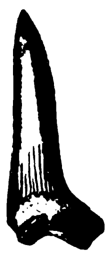

3


5


2


4


6


8


10

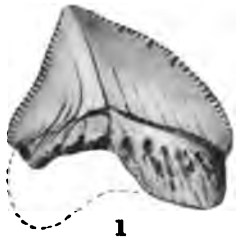

7


9


11

VERTEBRATA—REPTILIA AND PISCES

PLATE IX



1

2

6

3

7

4

8

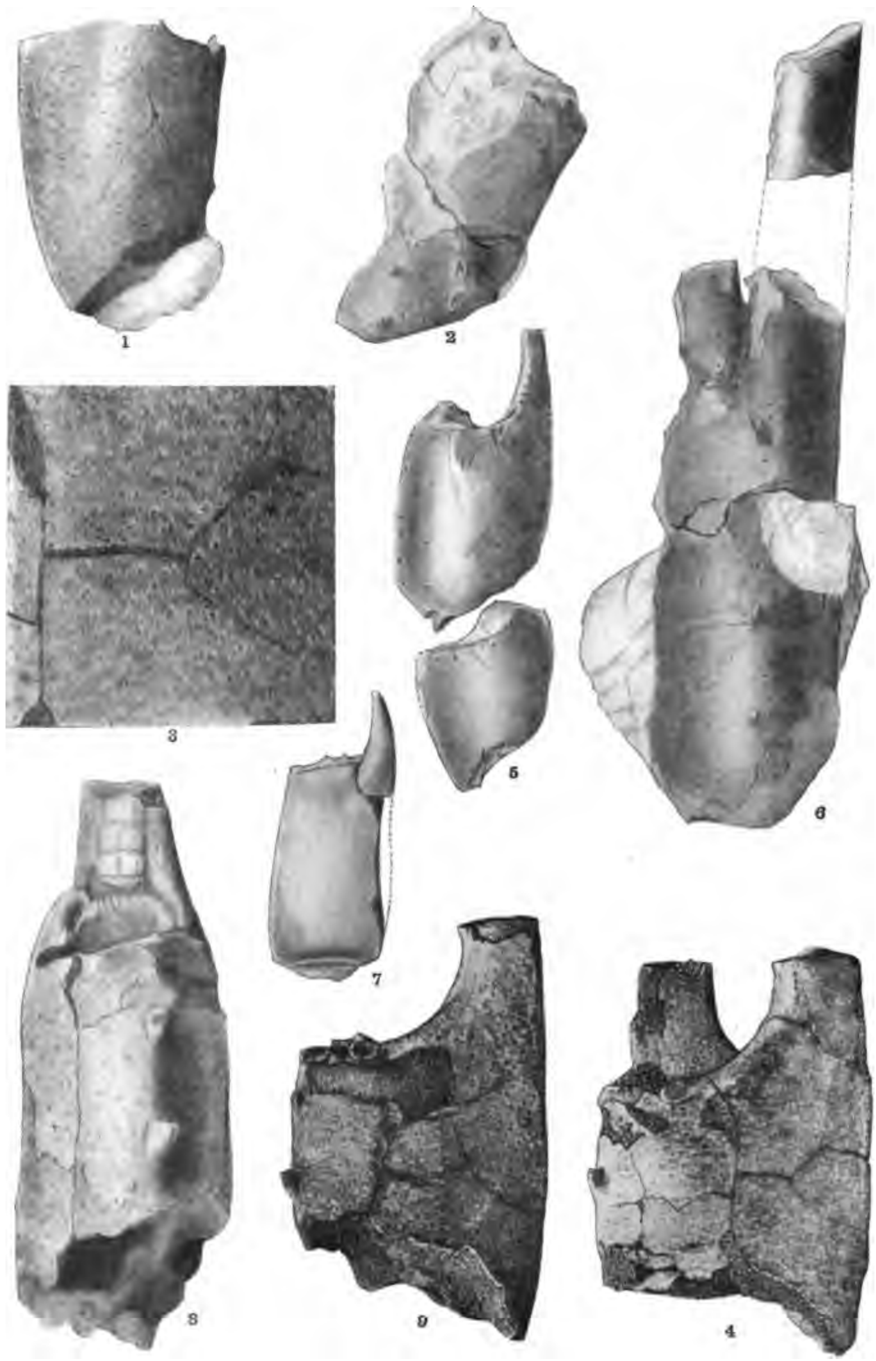
5

9

10

VERTEBRATA—PISCES

PLATE X



ARTHROPODA—CRUSTACEA

PLATE XII

PAGE

Fig. 1. Scaphites conradi (Morton) 383
Lateral view of fragment of whorl. Monmouth formation, Brightseat, Prince George's County.

Figs. 2, 3. Baculites ovatus Say 375
2. Lateral view.
3. Posterior view of same.
Matawan formation, near Summit Bridge, Chesapeake and Delaware Canal, Delaware.

Figs. 4-6. Belemnitella americana (Morton) 394
4. Median longitudinal section of rostrum showing radial fibers and cavity of phragmacone.
5. Ventral view of rostrum.
6. Ventral view of another specimen.
Monmouth formation, Bohemia Mills, Cecil County.

Fig. 7. Mortoniceras delawarensis (Morton) Weller 391
Peripheral view of portion of whorl. Matawan formation, near Summit Bridge, Chesapeake and Delaware Canal, Delaware.

Figs. 8, 9. Baculites asper Morton 377
8. Lateral view. × 1½.
9. Posterior view of same. × 1½.
Matawan formation, Post 218, Chesapeake and Delaware Canal, Delaware.

1

4

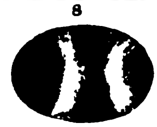
5

6

2

7

8



9

3

MOLLUSCA—CEPHALOPODA

PLATE XII A

PHALOPODA

PLATE XIII

	PAGE

Figs. 1, 2. POLYNICES (EUSPIRA) HALLI (Gabb) 499

1. Dorsal view.
2. Ventral view.

Monmouth formation, 2 miles southwest of Oxon Hill, Prince George's County.

Figs. 3, 4. AMAUROPSIS COMPACTA Gardner n. sp. 504

3. Dorsal view. $\times$ 3.
4. Ventral view. $\times$ 3.

Monmouth formation, McNeys Corners, Prince George's County.

Fig. 5. MARGARITES ELEVATA Gardner n. sp. 506

Dorsal view of internal cast. $\times$ 5. Monmouth formation, Brightseat, Prince George's County.

Fig. 6. MARGARITES DEPRESSA Gardner n. sp. 505

Ventral view of internal cast. $\times$ 5. Monmouth formation, Brightseat, Prince George's County.

Fig. 7. SOLARIUM MONMOUTHENSIS Gardner n. sp. 494

View of spire. $\times$ 2. Monmouth formation, 2 miles southwest of Oxon Hill, Prince George's County.

Fig. 8. GYRODES PETROSUS (Morton) Gabb 496

Dorsal view of internal cast with adhering portions of shell. Monmouth formation, Brightseat, Prince George's County.

Fig. 9. EUTREPHOCERAS DEKAYI (Morton) Hyatt 372

Lateral view of young individual. Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

Fig. 10. SPHENODISCUS LOBATUS (Tuomey) Meek 388

Lateral view of one of the earlier whorls. $\times$ 2. Monmouth formation, Brightseat, Prince George's County.

1

2

9

6

5

3

4

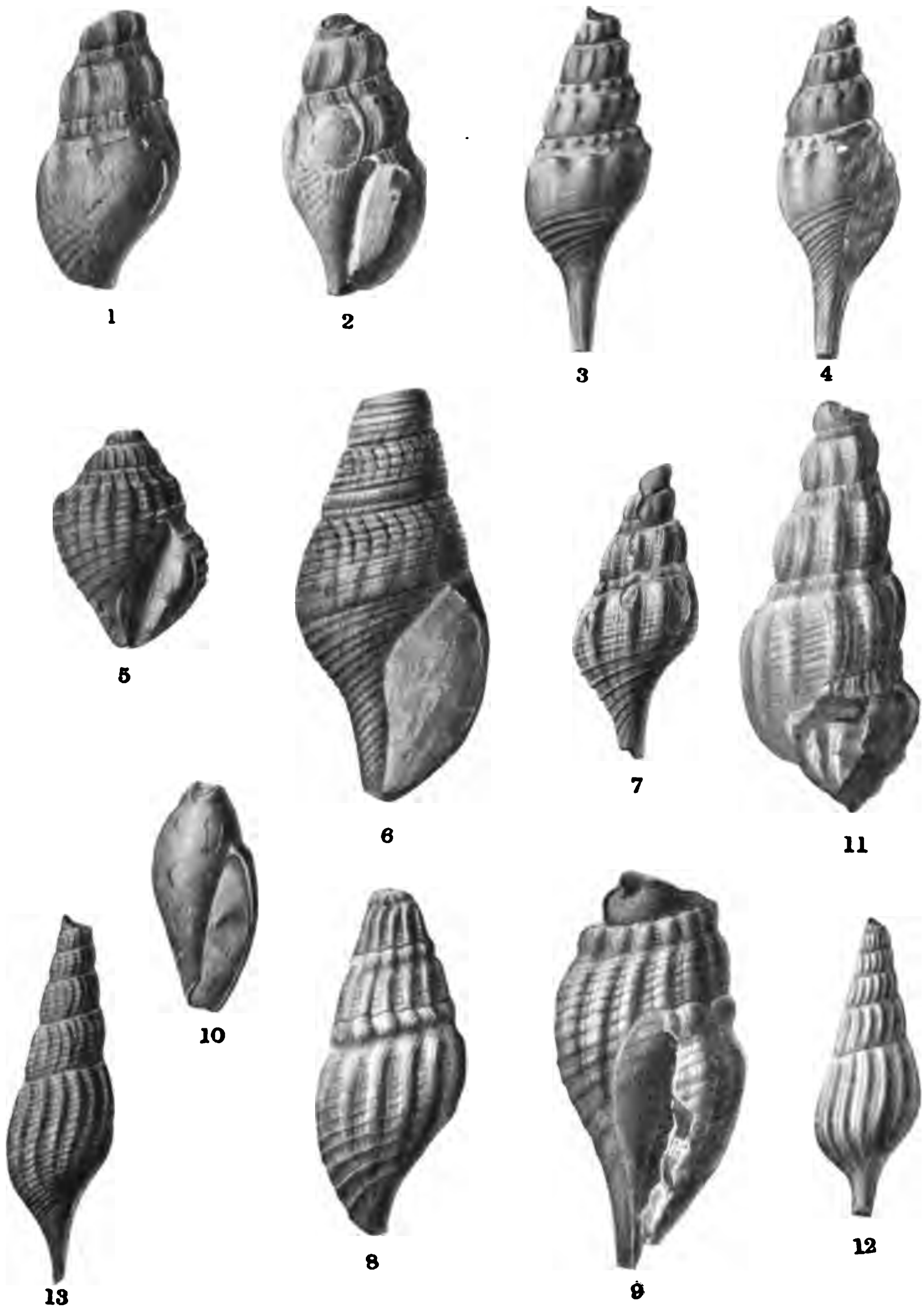
7

8

10

MOLLUSCA—CEPHALOPODA AND GASTROPODA

PLATE XIV



MOLLUSCA—GASTROPODA

PLATE XV

PAGE

Fig. 1. ROSTELLITES MARYLANDICUS Gardner n. sp. 424
Ventral view. Monmouth formation, Brightseat, Prince George's County.

Figs. 2, 3. ANCHURA (?) MONMOUTHENSIS Gardner n. sp. 476
2. Dorsal view of cast of interior.
3. Ventral view of same.
Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

Fig. 4. PYRIFUSUS VITTATUS Gardner n. sp. 458
Ventral view of a somewhat crushed specimen. Monmouth formation, Brightseat, Prince George's County.

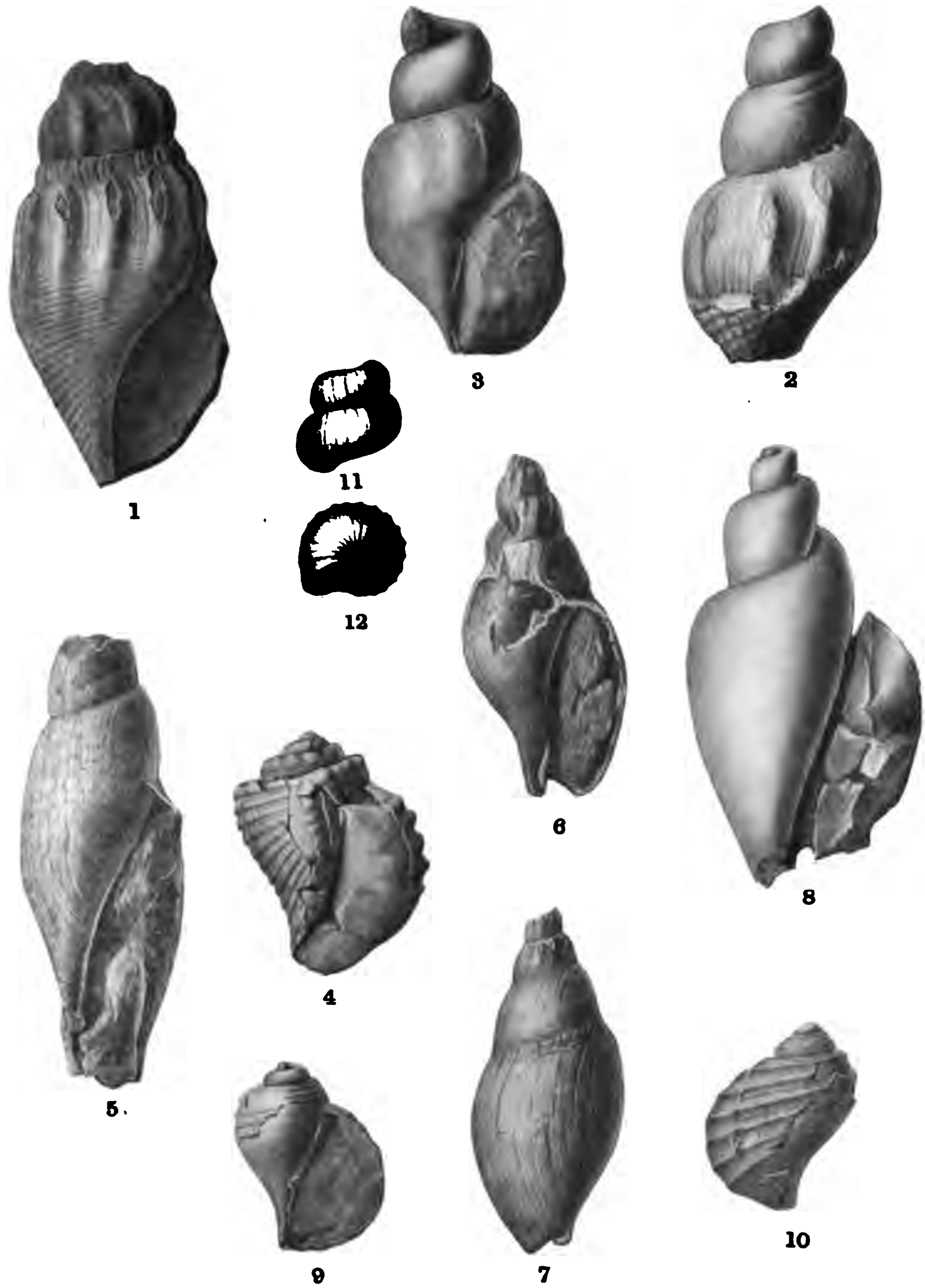
Fig. 5. LIOPEPLUM CRETACEUM (Conrad) 431
Ventral view. Monmouth formation, Brightseat, Prince George's County.

Figs. 6, 7. LIOPEPLUM MONMOUTHENSIS Gardner n. sp. 432
6. Ventral view.
7. Dorsal view.
Monmouth formation, 1 mile west of Friendly, Prince George's County.

Fig. 8. VOLUTOMORPHA CONRADI Gabb. 427
Ventral view of cast. Monmouth formation, 2 miles southwest of Oxon Hill, Prince George's County.

Figs. 9, 10. PYROPSIS RETIFER (Gabb) Whitfield 452
9. Ventral view of cast with portions of shell adhering. × 2.
10. Dorsal view of same. × 2.
Monmouth formation, Brightseat, Prince George's County.

Figs. 11, 12. EPITONIUM CECILIUM Gardner n. sp. 479
11. Dorsal view of several whorls.
12. Basal view of same.
Monmouth formation, Bohemia Mills, Cecil County.



MOLLUSCA—GASTROPODA

PLATE XVI

PAGE

Figs. 1, 2. PYROPSIS TROCHIFORMIS (Tuomey) Gabb 446

1. Ventral view.
2. View of spire.

Monmouth formation, Brightseat, Prince George's County.

Fig. 3. PYROPSIS LENOLENSIS Weller 453

View of squeeze of mold of exterior. Matawan formation, locality unknown.

Fig. 4. PYRIFUSUS sp. (immature) 463

View of squeeze of mold of exterior. Monmouth formation, 2 miles southwest of Oxon Hill, Prince George's County.

Figs. 5, 6. PYRIFUSUS MONMOUTHENSIS Gardner n. sp 459

5. Dorsal view.
6. Ventral view.

Monmouth formation, Brightseat, Prince George's County.

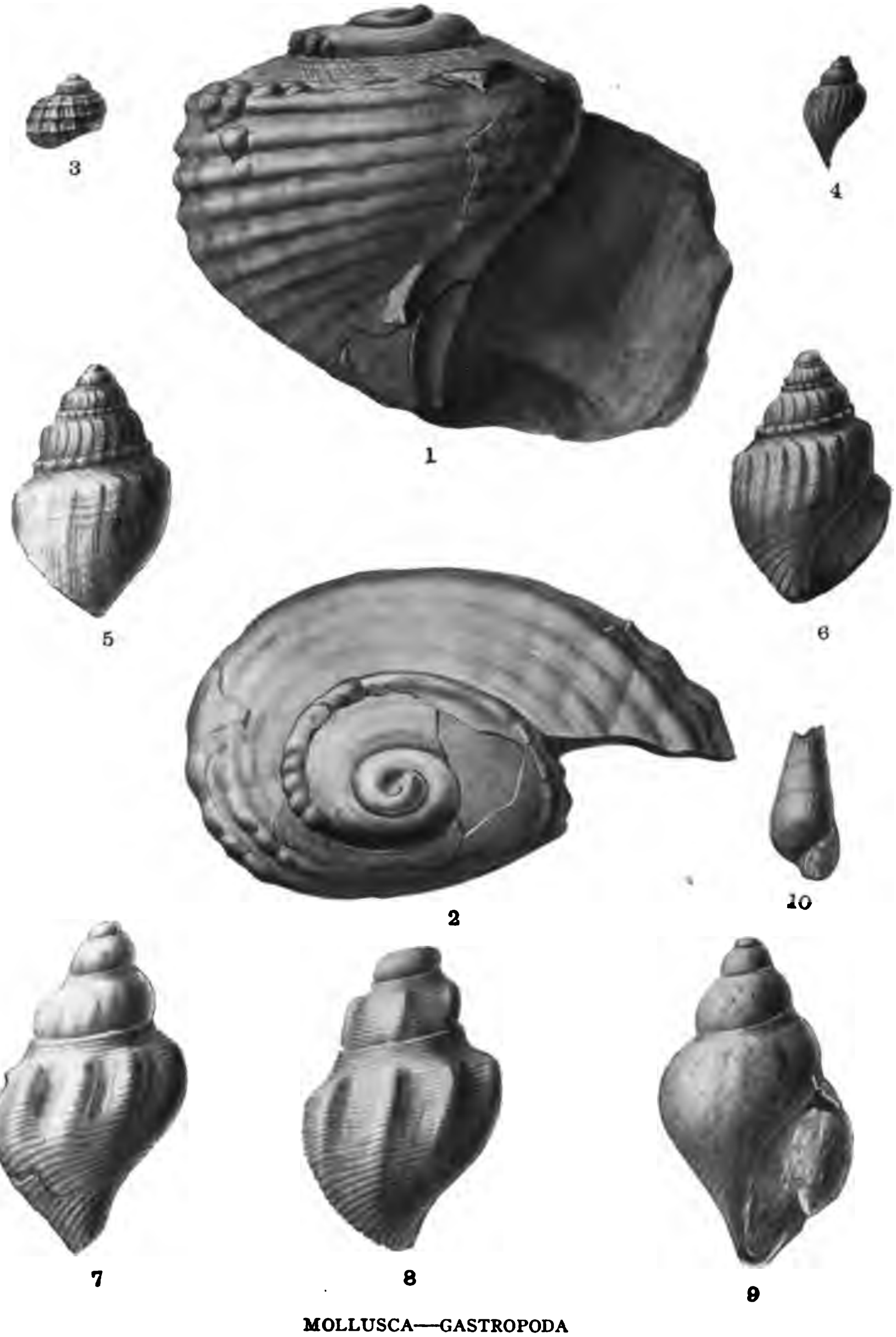
Figs. 7-9. PYRIFUSUS MARYLANDICUS Gardner n. sp 457

7. Dorsal view of cast. × 2.
8. Ventral view of same. × 2.
9. View of squeeze of mold of exterior. × 2.

Monmouth formation, Brightseat, Prince George's County.

Fig. 10. PSEUDOMELANIA MONMOUTHENSIS Gardner n. sp 480

Ventral view. × 3. Monmouth formation, Brightseat, Prince George's County.



MOLLUSCA—GASTROPODA

PLATE XVII

PAGE

Fig. 1. Turritella paravertebroides Gardner n. sp.................... 488
View of several whorls. Monmouth formation, Brightseat, Prince George's County.

Fig. 2. Volutomorpha perornata Gardner n. sp...................... 428
Dorsal view. × 2. Monmouth formation, Brightseat, Prince George's County.

Figs. 3, 4. Turritella delmar Gardner n. sp......................... 487
3. Squeeze of mold of exteriors. × 2.
4. Internal cast. × 2.
Matawan formation, Post 105, Chesapeake and Delaware Canal, Delaware.

Figs. 5, 6. Pugnellus goldmani Gardner n. sp........................ 469
5. Ventral view.
6. Dorsal view.
Monmouth formation, Brightseat, Prince George's County.

Fig. 7. Epitonium marylandicum Gardner n. sp...................... 478
View of several whorls. × 3. Monmouth formation, Brightseat, Prince George's County.

Figs. 8, 9. Serpulorbis marylandica Gardner n. sp................... 482
8. Upper surface of two constituent tubes. × 2.
9. Lower surface of same. × 2.
Monmouth formation, Brightseat, Prince George's County.

Fig. 10. Turritella bonaspes Gardner n. sp........................... 487
View of squeeze of mold. × 2. Magothy formation, Good Hope Hill near Anacostia, D. C.


1


2


3


4


5


7


6


8


10


9

MOLLUSCA—GASTROPODA

PLATE XVIII

PAGE

Figs. 1, 2. RINGICULA CLARKI Gardner n. sp. 400
1. Dorsal view. × 3.
2. Ventral view. × 3.
Monmouth formation, Brightseat, Prince George's County.

Figs. 3, 4. ACTEON LINTEUS (Conrad) 397
3. Dorsal view. × 3.
4. Ventral view. × 3.
Monmouth formation, Brightseat, Prince George's County.

Figs. 5, 6. AVELLANA PINGUIS Gardner n. sp. 406
5. Dorsal view. × 2.
6. Ventral view. × 2.
Monmouth formation, Brightseat, Prince George's County.

Fig. 7. AVELLANA LINTONI Gardner n. sp. 406
Dorsal view. × 2. Monmouth formation, 2 miles southwest of Oxon Hill, Prince George's County.

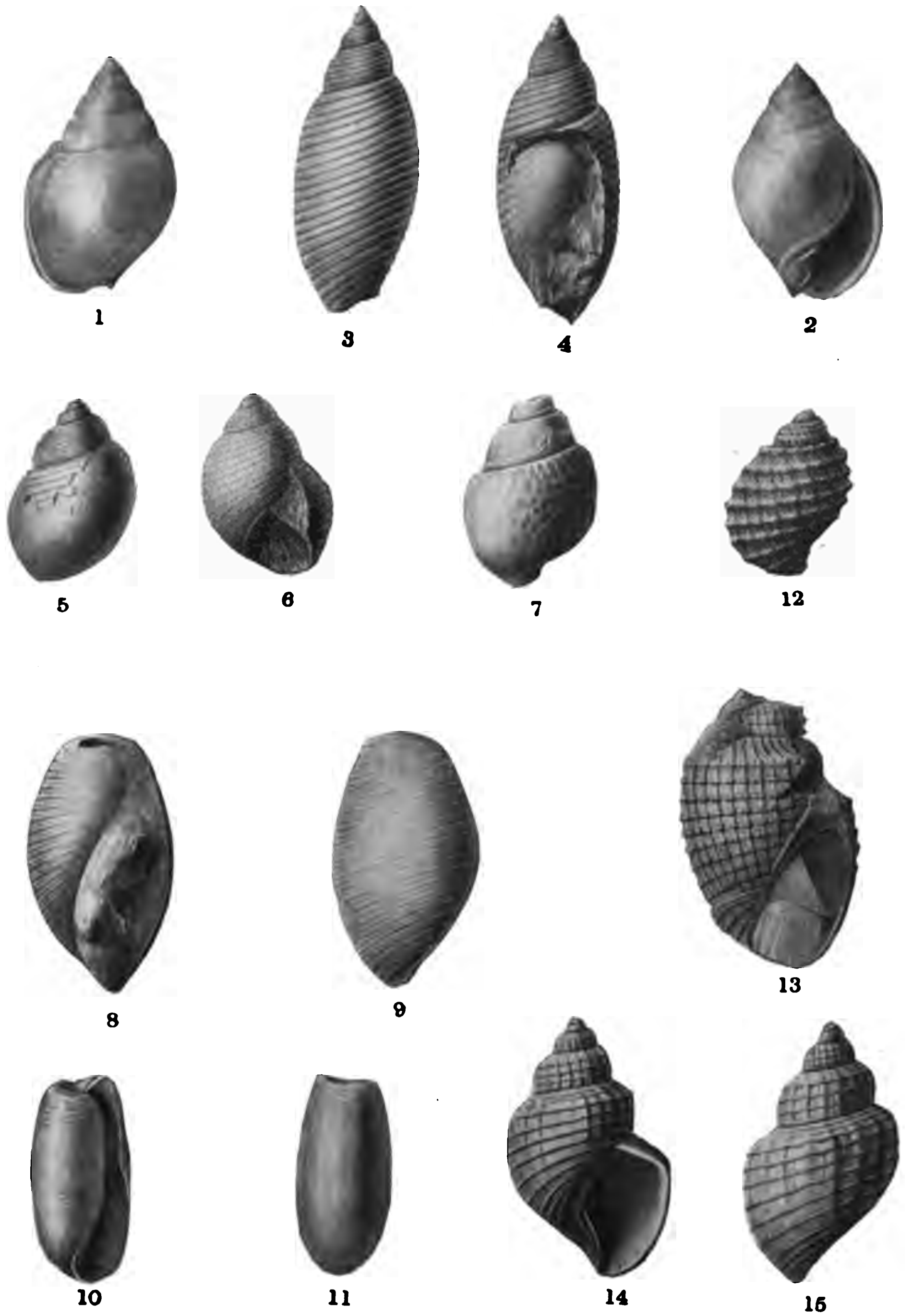
Figs. 8, 9. HAMINEA CYLINDRICA Gardner n. sp. 409
8. Ventral view. × 2.
9. Dorsal view. × 2.
Monmouth formation, Brightseat, Prince George's County.

Figs. 10, 11. CYLICHNA RECTA Gabb 411
10. Ventral view. × 3.
11. Dorsal view. × 3.
Monmouth formation, Brightseat, Prince George's County.

Fig. 12. MOREA NATICELLA Gabb 465
Squeeze of mold of exterior. Matawan formation, locality unknown.

Fig. 13. MOREA MARYLANDICA Gardner n. sp. 466
Ventral view. × 2. Monmouth formation, 2 miles southwest of Oxon Hill, Prince George's County.

Figs. 14, 15. PALADMETE CANCELLARIA (Conrad) 413
14. Ventral view. × 2.
15. Dorsal view. × 2.
2½ miles south of Dumas, Texas, U. S. National Museum.



MOLLUSCA—GASTROPODA

PLATE XIX

PAGE

Figs. 1-4. NUCULA SLACKIANA Gabb.................................... 511
1. Exterior of left valve.
2. Ventral view of double valves.
3. Dorsal view of double valves.
4. Dorsal view of right valve. × 2.
Monmouth formation, 1 mile west of Friendly, Prince George's County.

Figs. 5, 6. NUCULA AMICA Gardner n. sp.............................. 514
5. Interior of right valve. × 3.
6. Exterior of same. × 3.
Monmouth formation, 1 mile west of Friendly, Prince George's County.

Fig. 7. NUCULA MICROSTRIATA Gardner n. sp........................... 515
Exterior of right valve. × 3. Monmouth formation, Brightseat, Prince George's County.

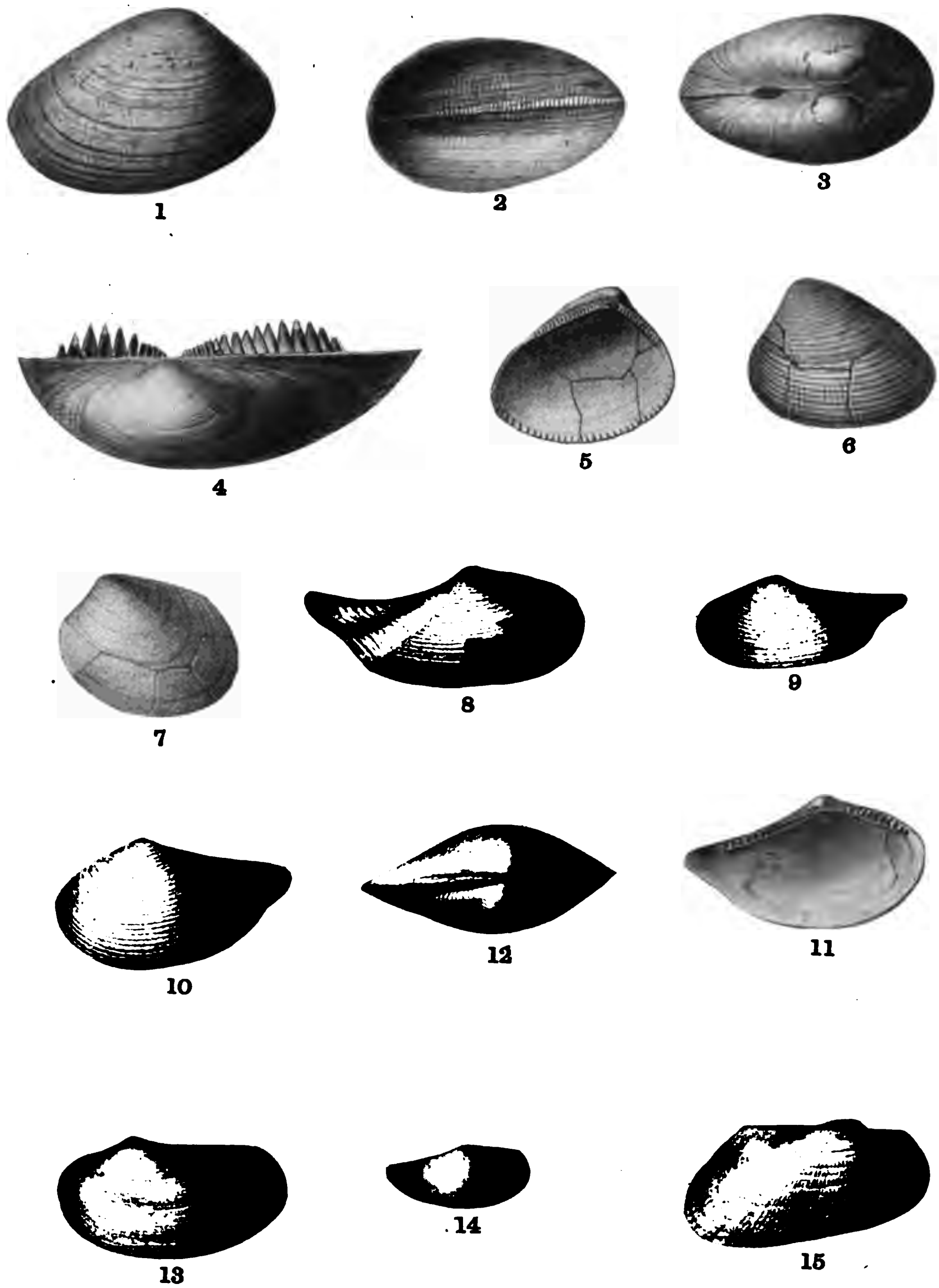
Figs. 8, 9. LEDA ROSTRATRUNCATA Gardner n. sp........................ 517
8. Exterior of right valve. × 2. Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.
9. Exterior of left valve. × 2. Monmouth formation, 1 mile west of Friendly, Prince George's County.

Figs. 10-12. LEDA WHITFIELDI Gardner n. sp.......................... 516
10. Exterior of left valve. × 4.
11. Interior of same. × 4.
Monmouth formation, Friendly, Prince George's County.
12. Dorsal view of double valves. × 5. Monmouth formation, Brightseat, Prince George's County.

Fig. 13. YOLDIA LONGIFRONS (Conrad) Johnson........................ 518
Exterior of left valve. Ripley formation, Union County, Mississippi, U. S. National Museum.

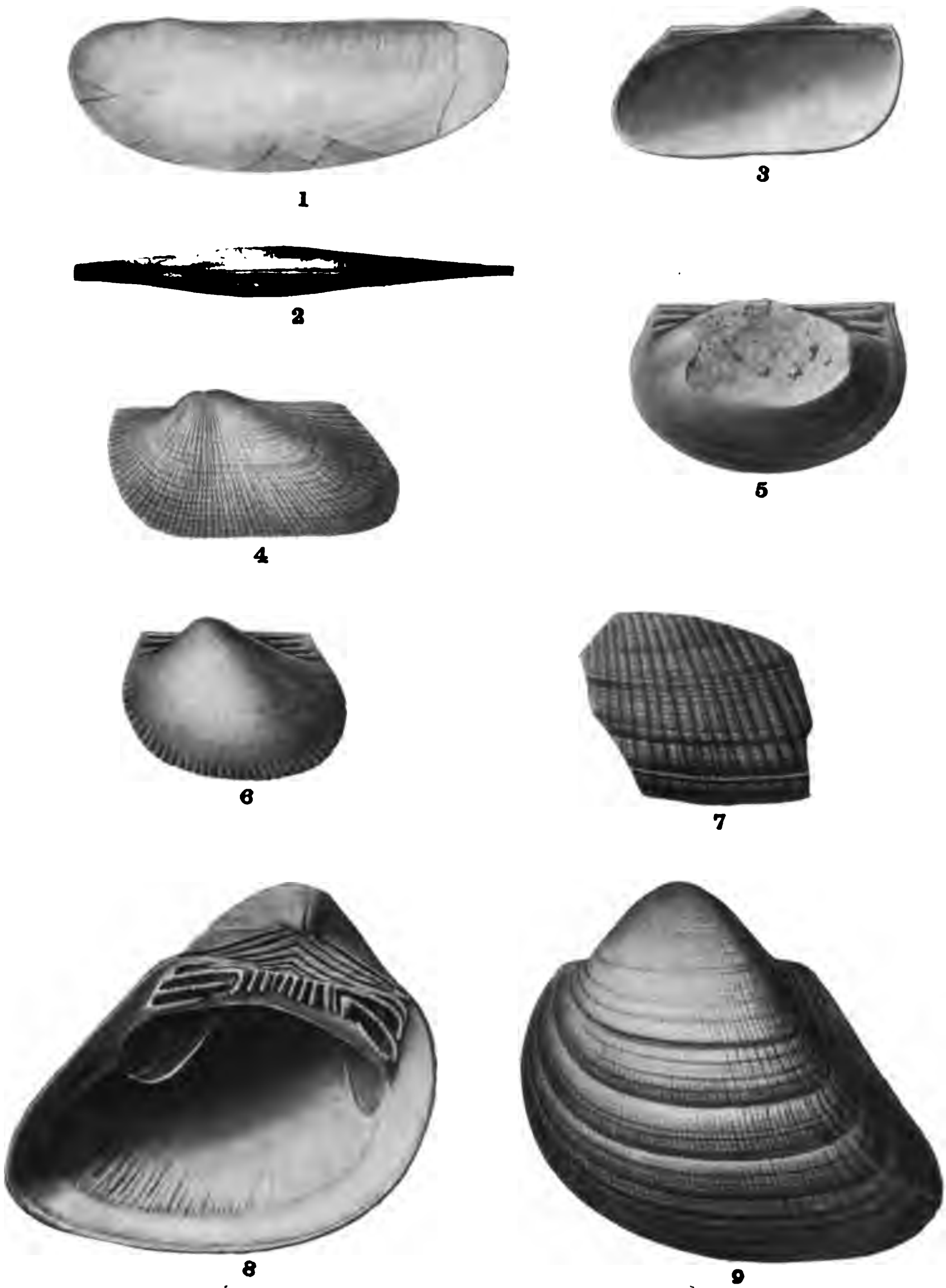
Fig. 14. YOLDIA NOXONTOWNENSIS Gardner n. sp........................ 521
Cast of right valve. Manasquan formation, South Feeder Noxontown Pond, Delaware.

Fig. 15. NEMODON STANTONI Gardner n. sp............................ 527
Exterior of right valve. Monmouth formation, Brightseat, Prince George's County.



MOLLUSCA—PELECYPODA

PLATE XX



MOLLUSCA—PELECYPODA

PLATE XXI

PAGE

Figs. 1, 2. CUCULLÆA VULGARIS Morton 529
1. Exterior of left valve of immature specimen.
2. Interior of same.
Ripley formation, Ripley, Mississippi, U. S. National Museum.

Figs. 3, 4. ARCA SAFFORDI Gabb 537
3. Interior of left valve. × 6.
4. Exterior of same. × 6.
Monmouth formation, Brightseat, Prince George's County.

Figs. 5, 6. ARCA UANDI Gardner n. sp. 539
5. Cast of double valves from right side.
6. Anterior view of same.
Matawan formation, Camp U. & I., Chesapeake and Delaware Canal, Delaware.

Figs. 7-9. GLYCYMERIS (POSTLIGATA) WORDENI Gardner n. sub. gen. et sp... 543
7. Interior of left valve. × 5.
8. Exterior of right valve. × 3.
9. Posterior view of double valves. × 3.
Monmouth formation, Friendly, Prince George's County.

Fig. 10. PTERIA PETROSA (Conrad) Meek 548
Cast of left valve. Monmouth formation, Bohemia Mills, Cecil County.

Fig. 11. PTERIA RHOMBICA Gardner n. sp. 549
Hinge of left valve. × 5. Monmouth formation, 1 mile west of Friendly, Prince George's County.

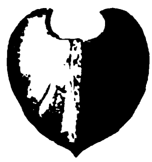
Fig. 12. PINNA LAQUEATA Conrad 545
Broken cast of double valves. Matawan formation, Post 105, Chesapeake and Delaware Canal, Delaware.

1

2

3

5



6

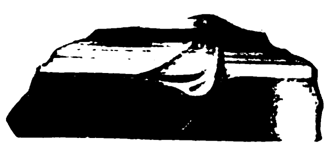
4

7

8

9

10

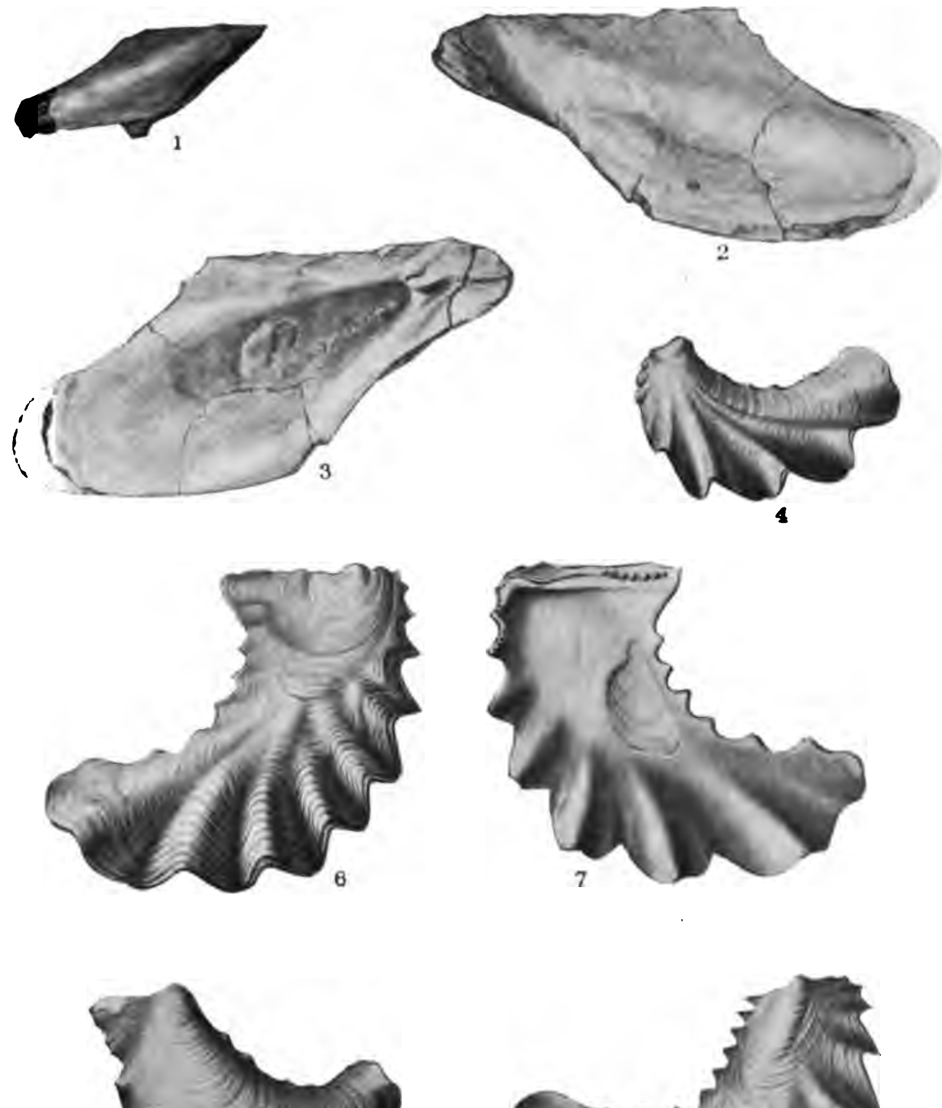


11

12

MOLLUSCA—PELECYPODA

PLATE XXII



MOLLUSCA—PELECYPODA

PLATE XXIII

PAGE

Figs. 1, 2. OSTREA LARVA SUBSP. MESENTERICA Morton 555

1. Interior of left valve. × 1½.
2. Exterior of same. × 1½.

Monmouth formation, Brightseat, Prince George's County.

Fig. 3. OSTREA SUBSPATULATA Forbes 561

Interior of left valve. Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

Figs. 4, 5. OSTREA MONMOUTHENSIS Weller 558

4. Interior of right valve.
5. Exterior of same.

Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

1

2

3

4

5

MOLLUSCA—PELECYPODA

PLATE XXIV

PAGE

Fig. 1. OSTREA SUBSPATULATA Forbes.................................. 561
Exterior of left valve. Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

Figs. 2-4. OSTREA TECTICOSTA Gabb.................................. 560
2. Interior of left valve. × 2.
3. Exterior of same. × 2.
Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.
4. Double valves from the right side. × 2. Monmouth formation, Brightseat, Prince George's County.

Figs. 5, 6. OSTREA FABA Gardner n. sp.................................. 559
5. Exterior of right valve.
6. Interior of same.
Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

2

3

1

4

5

6

MOLLUSCA—PELECYPODA

PLATE XXV

PAGE

Figs. 1-4. OSTREA (GRYPHOSTREA) VOMER (Morton) Meek................ 579

1. Exterior of left valve. × 2.
2. Interior of same. × 2.

Matawan formation, Camp Fox, Chesapeake and Delaware Canal, Delaware.

3. Interior of right valve. × 2.
4. Exterior of same. × 2.

Monmouth formation, Brightseat, Prince George's County.

Fig. 5. EXOGYRA COSTATA Say.. 564

Exterior of left valve. Monmouth formation, Brightseat, Prince George's County.

1

2

5

3

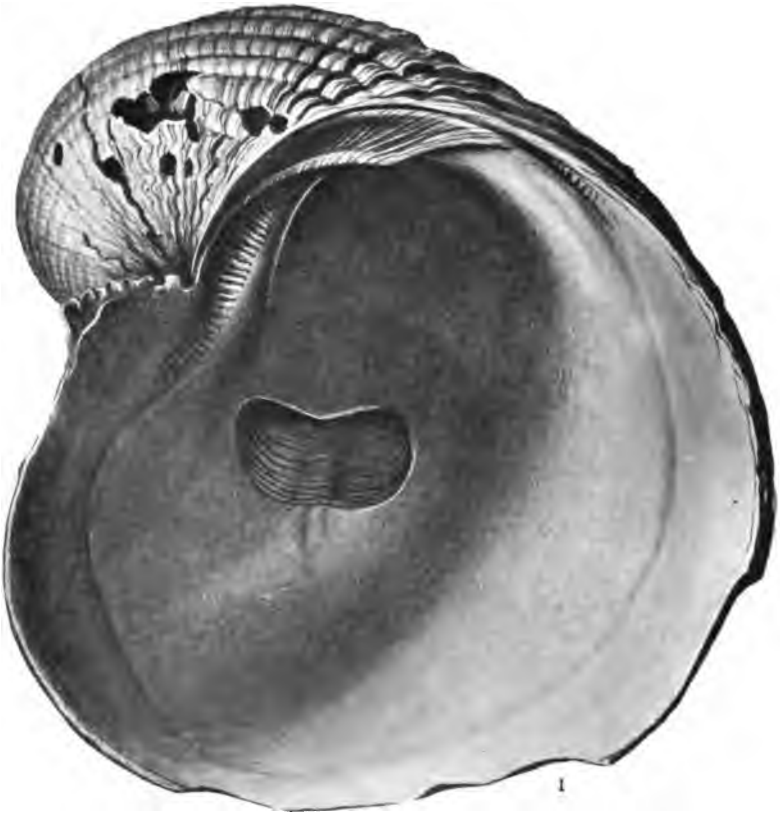
4

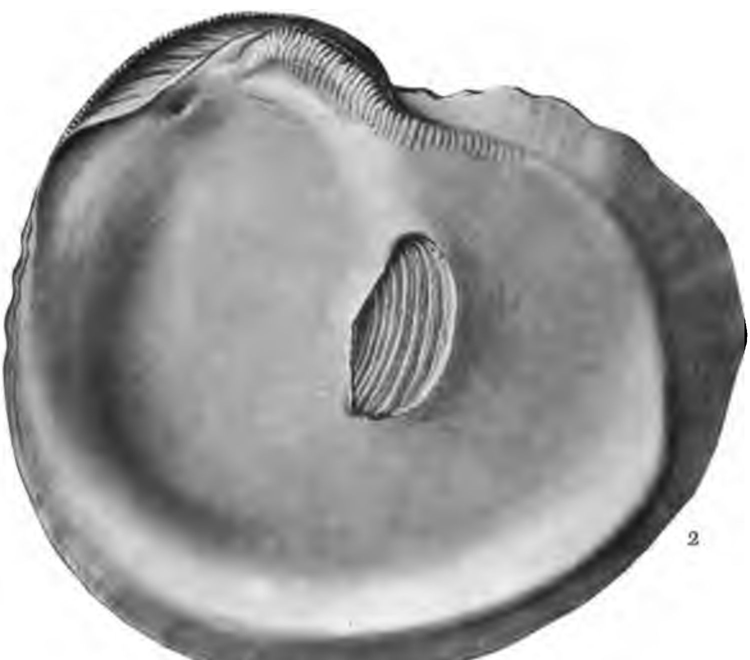
MOLLUSCA—PELECYPODA

PLATE XXVI

1. Interior of left valve.
2. Interior of right valve.

Monmouth formation, Brightseat, Prince George's County.


1


2

MOLLUSCA—PELECYPODA

PLATE XXVII

PAGE

Figs. 1, 2. EXOGYRA COSTATA Say 564

1. Exterior of right valve. Monmouth formation, Brightseat, Prince George's County.
2. Exterior of left valve. Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

Fig. 3. EXOGYRA COSTATA SUBSP. CANCELLATA Stephenson 566

Exterior of left valve. Monmouth formation, head of Little Bohemia Creek, Cecil County.

1

2

3

MOLLUSCA—PELECYPODA

PLATE XXVIII

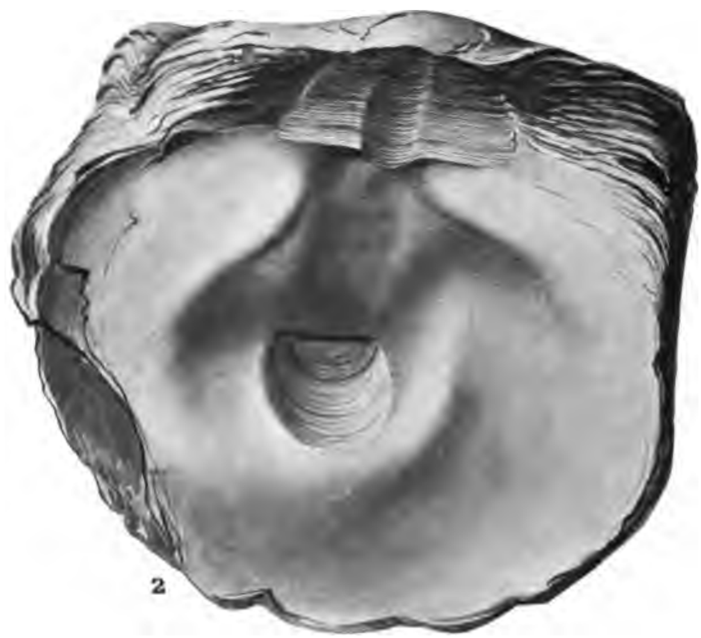
PAGE

Figs. 1, 2. GRYPHÆA (PYCNODONTE) VESICULARIS (Lamarck) Race A..... 575

1. Exterior of left valve.
2. Interior of same.

Matawan formation, Camp Fox, Chesapeake and Delaware Canal, Delaware.

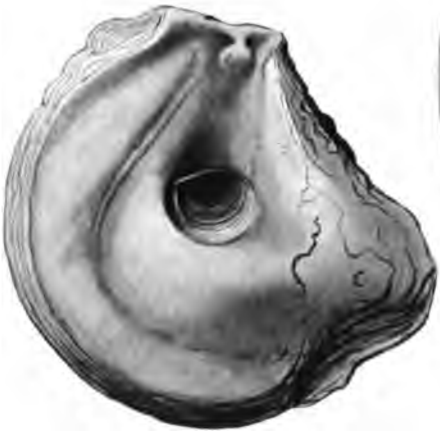
1



2

MOLLUSCA—PELECYPODA

PLATE XXIX



1

2

3

MOLLUSCA—PELECYPODA

PLATE XXX

PAGE

Figs. 1, 2. GRYPHÆA (PYCNODONTE) VESICULARIS (Lamarck) Race B..... 576

1. Exterior of left valve.
2. Exterior of right valve of same individual.

Matawan formation, Camp Fox, Chesapeake and Delaware Canal, Delaware.

Figs. 3, 4. GRYPHÆA (PYCNODONTE) VESICULARIS (Lamarck) Race indet.

3. Exterior of immature right valve. $\times$ 2.
4. Interior of same, showing excentric posterior adductor of young.

Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

1

3

4

2

MOLLUSCA—PELECYPODA

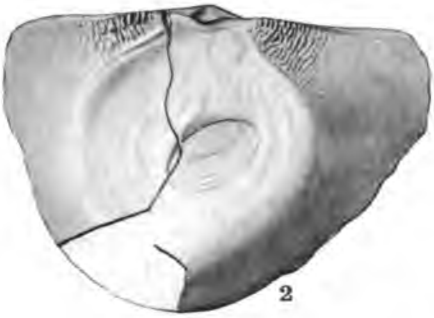
PLATE XXXI

PAGE

Figs. 1-3. GRYPHÆA (PYCNODONTE) VESICULARIS (Lamarck) Race D.. .. 576

1. Exterior of adult left valve.
2. Interior of right valve.
3. Interior of left valve of same individual.

Monmouth formation, Brightseat, Prince George's County.



2

3

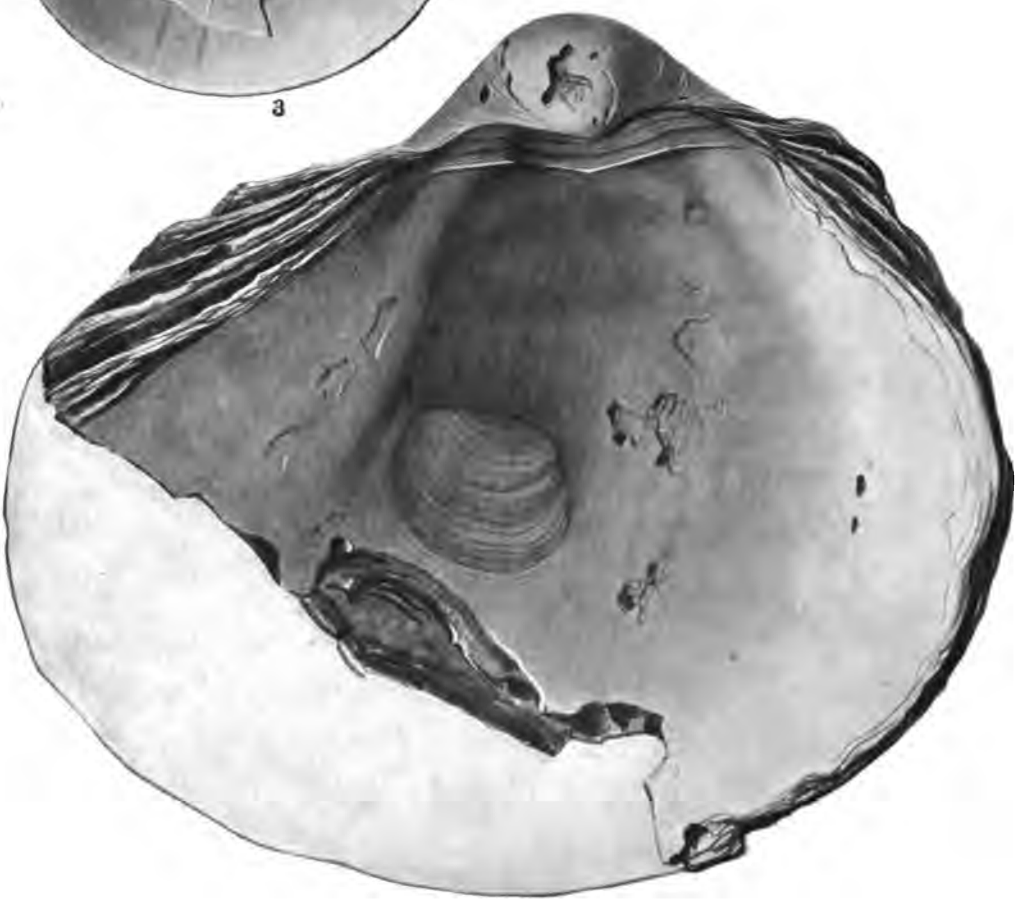
1

MOLLUSCA—PELECYPODA

PLATE XXXII

2

3



1

MOLLUSCA—PELECYPODA

PLATE XXXIII

PAGE

Figs. 1-3. GRYPHÆA (PYCNODONTE) VESICULARIS (Lamarck) Race E..... 576

1. Exterior of left valve.
2. Interior of same.
3. Interior of right valve.

Manasquan formation, Noxontown Mill Pond, Delaware.

Figs. 4-6. GRYPHÆA (PYCNODONTE) PUSILLA Gardner n. sp.............. 578

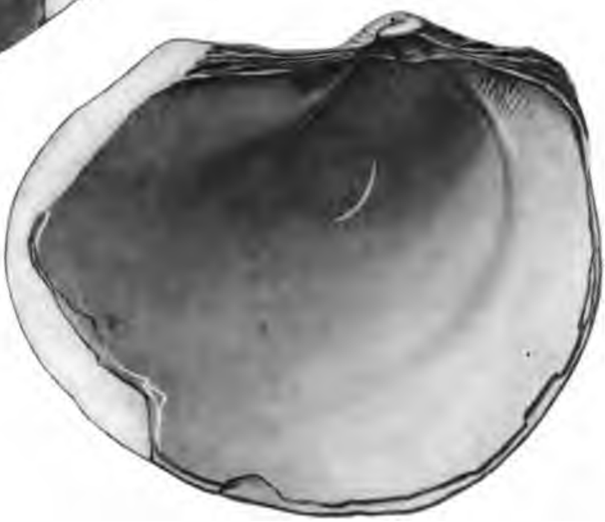
4. Exterior of left valve.
5. Interior of same.
6. Interior of right valve.

Monmouth formation, Great Bohemia Creek, Cecil County.


1


3


6


2


4


5

MOLLUSCA—PELECYPODA

PLATE XXXIV

PAGE

Figs. 1, 2. TRIGONIA EUFALENSIS Gabb 582

1. Exterior of right valve. × 2.
2. Interior of same. × 2.

Monmouth formation, Brightseat, Prince George's County.

Figs. 3-5. PECTEN ARGILLENSIS Conrad 588

3. Exterior of immature left valve. × 2.
4. Exterior of adult left valve.
5. Portion of sculpture of same. × 5.

Monmouth formation, Brightseat, Prince George's County.

Figs. 6, 7. PECTEN VENUSTUS Morton 591

6. Exterior of right valve. × 3.
7. Exterior of left valve. × 3.

Houston, Mississippi, U. S. National Museum.

Figs. 8, 9. PECTEN SIMPLICIUS Conrad 595

8. Exterior of left valve. × 2.
9. Exterior of right valve. × 2.

Monmouth formation, Brightseat, Prince George's County.

Fig. 10. PECTEN QUINQUECOSTATA Sowerby 596

Cast of interior of right valve. Matawan formation, Camp Fox, Chesapeake and Delaware Canal, Delaware.

Fig. 11. LIMA OBLIQUA Gardner n. sp. 603

Exterior of left valve. × 3. Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

Figs. 12, 13. LIMA RETICULATA Forbes 600

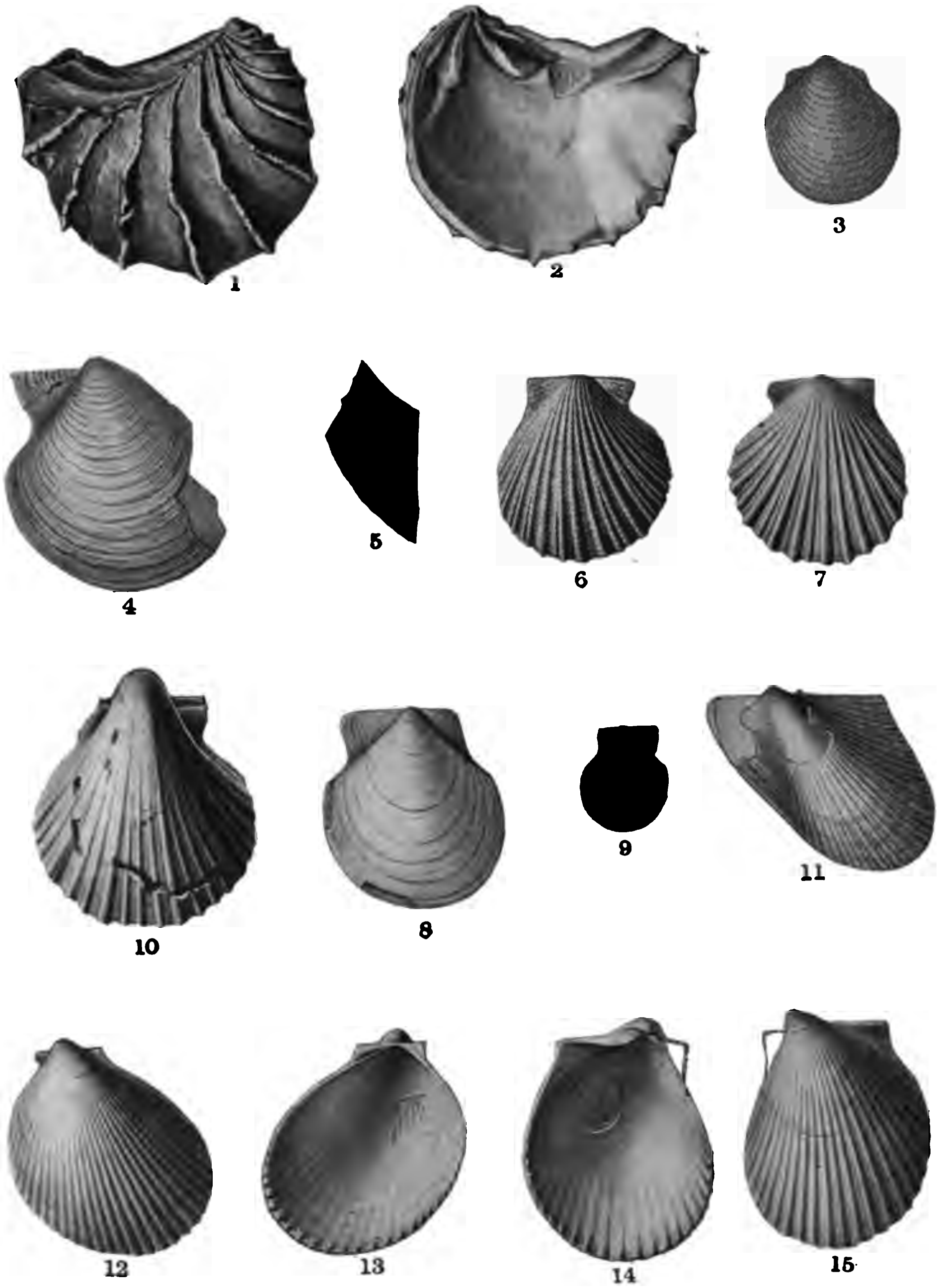
12. Exterior of right valve. × 5.
13. Interior of same. × 5.

Monmouth formation, Brightseat, Prince George's County.

Figs. 14, 15. LIMA SERRATA Gardner n. sp. 602

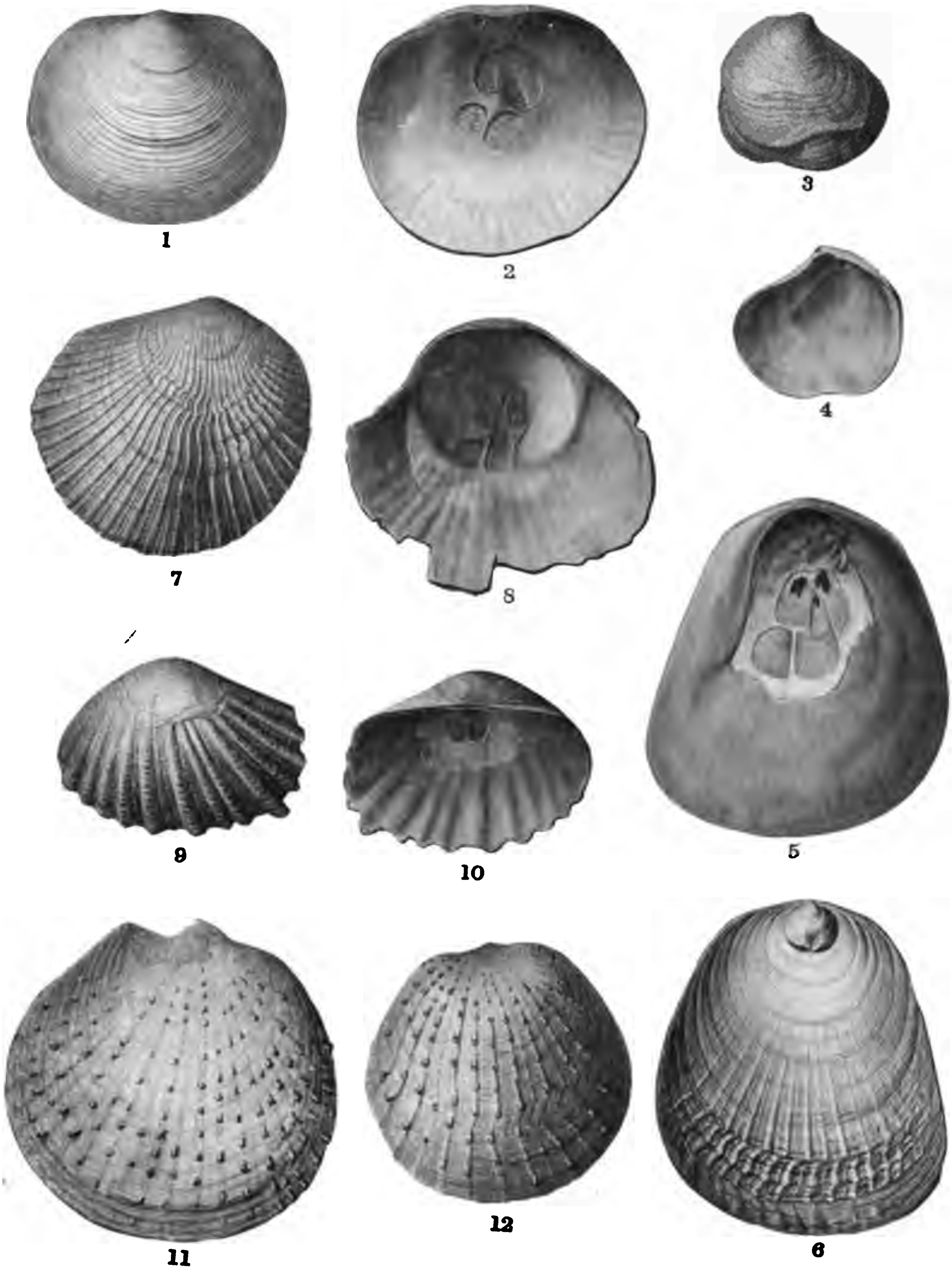
14. Interior of left valve. × 4.
15. Exterior of same. × 4.

Monmouth formation, 1 mile west of Friendly, Prince George's County.



MOLLUSCA—PELECYPODA

PLATE XXXV



MOLLUSCA—PELECYPODA

PLATE XXXVI

PAGE

Figs. 1, 2. Modiolus sedesclarus Gardner n. sp. 616
1. Exterior of right valve.
2. Dorsal view of double valves.
Monmouth formation, Brightseat, Prince George's County.

Fig. 3. Modiolus trigonus Gardner n. sp. 616
Exterior of left valve. × 2. Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

Figs. 4-6. Lithophaga ripleyana Gabb 618
4. Cast of double valves from right side.
5. Front view of same.
Matawan formation, Post 198-199, Chesapeake and Delaware Canal, Delaware.
6. Aggregation of casts. Matawan formation, Camp Fox, Chesapeake and Delaware Canal, Delaware.

Figs. 7-9. Lithophaga conchafodentis Gardner n. sp. 619
7. Cast of double valves from right side. × 3.
8. Dorsal view of same. × 3.
9. Left valve *in situ*.
Monmouth formation, Brightseat, Prince George's County.

Figs. 10, 11. Lithophaga juliæ (Lea) 620
10. Double valves from right side. × 2.
11. Front view of same. × 2.
Monmouth formation, Brightseat, Prince George's County.

Figs. 12, 13. Lithophaga twitchelli Gardner n. sp. 622
12. Double valves from right side. × 1½.
13. Front view of same. × 1½.
Monmouth formation, railroad cut 1 mile west of Seat Pleasant, Prince George's County.

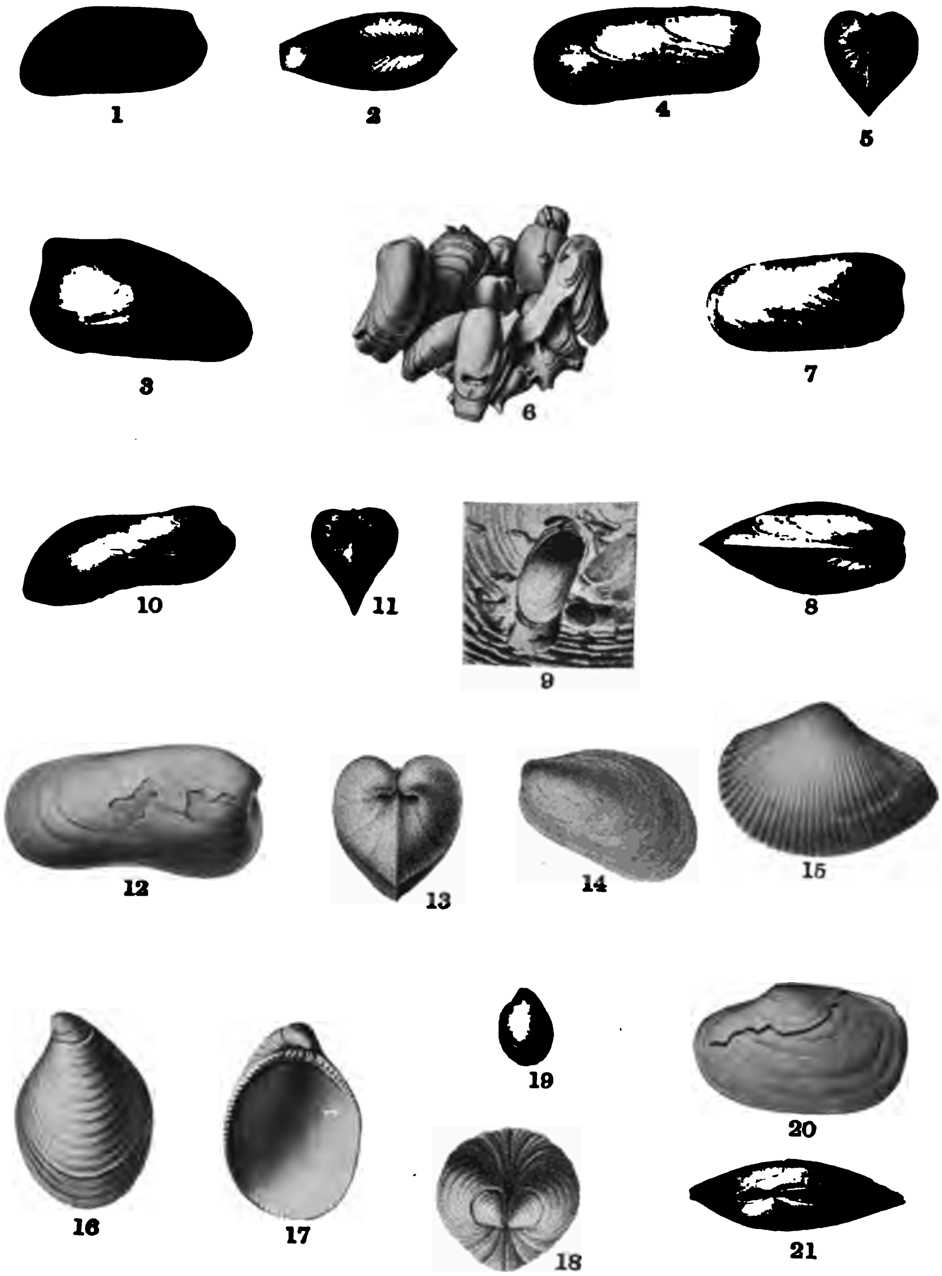
Fig. 14. Lithophaga lingua Gardner n. sp. 621
Exterior of left valve. × 3. Monmouth formation, Brightseat, Prince George's County.

Fig. 15. Liopistha protexta Conrad 636
Exterior of left valve. Monmouth formation, Brightseat, Prince George's County.

Figs. 16-18. Crenella serica Conrad 624
16. Exterior of left valve. × 6.
17. Interior of same. × 6.
18. Dorsal view of double valves. × 6.
Monmouth formation, Brightseat, Prince George's County.

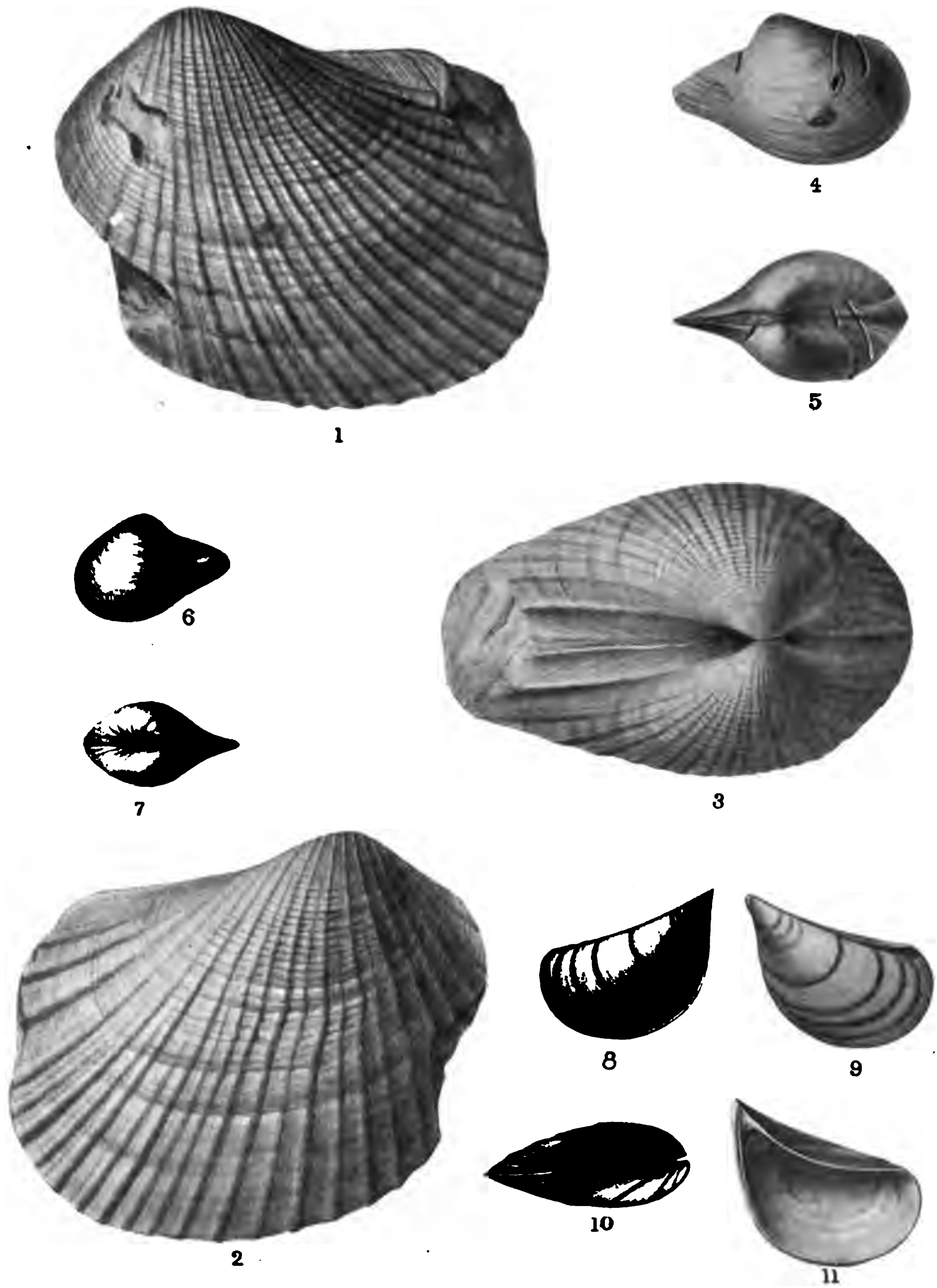
Fig. 19. Crenella elegantula Meek and Hayden 625
Cast of left valve. Monmouth formation, Brightseat, Prince George's County.

Figs. 20, 21. Solyma lineolata Conrad 701
20. Double valves from left side.
21. Dorsal view of same.
Chatfield, Navarro County, Texas, U. S. National Museum.



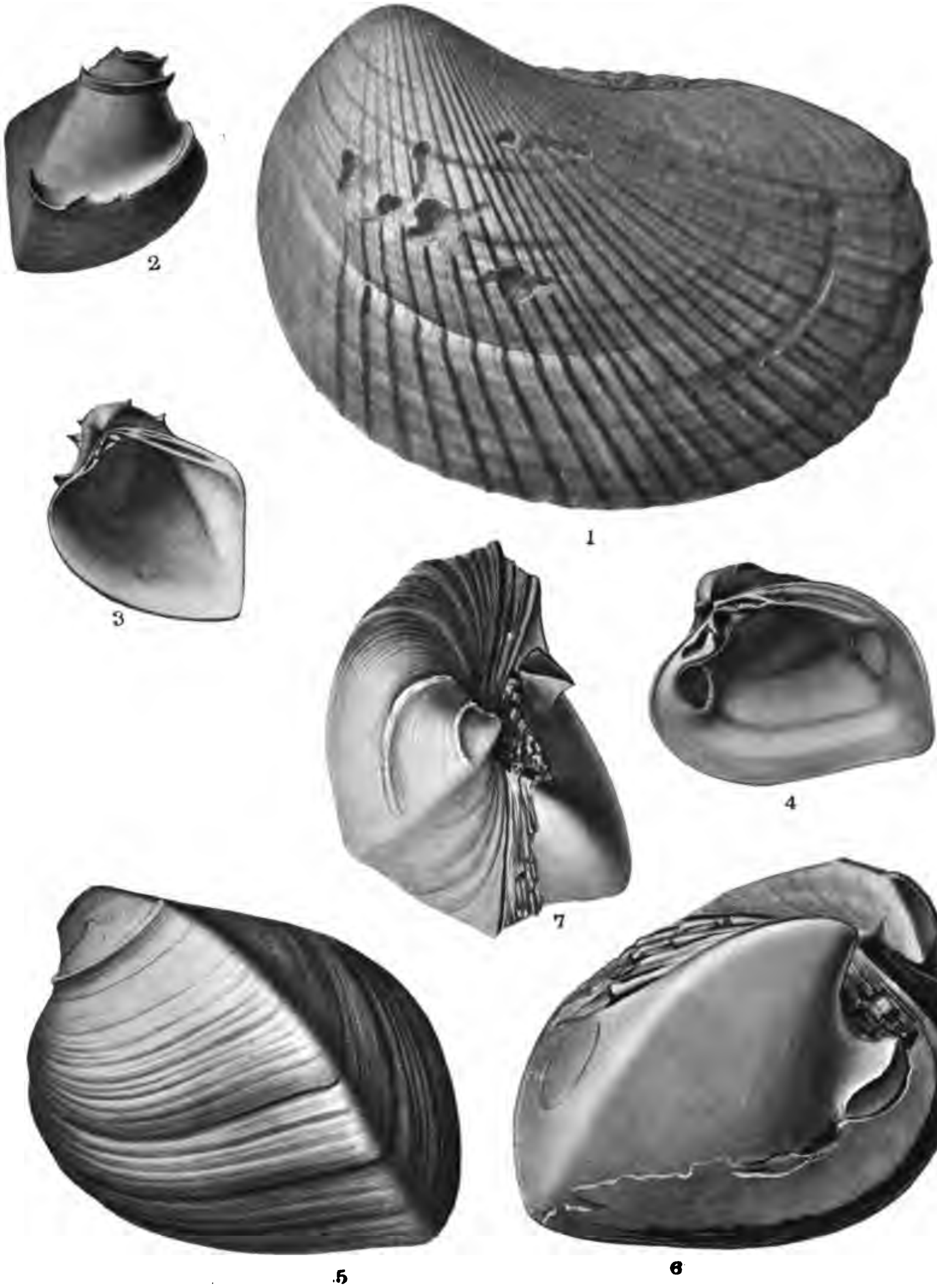
MOLLUSCA—PELECYPODA

PLATE XXXVII



MOLLUSCA—PELECYPODA

PLATE XXXVIII



MOLLUSCA—PELECYPODA

PLATE XXXIX

1

2

3

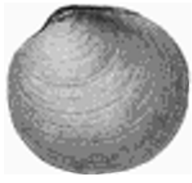
4

5

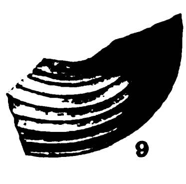
6

7

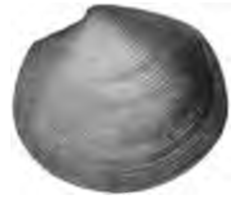
10



8



9



11

MOLLUSCA—PELECYPODA

PLATE XL

PAGE

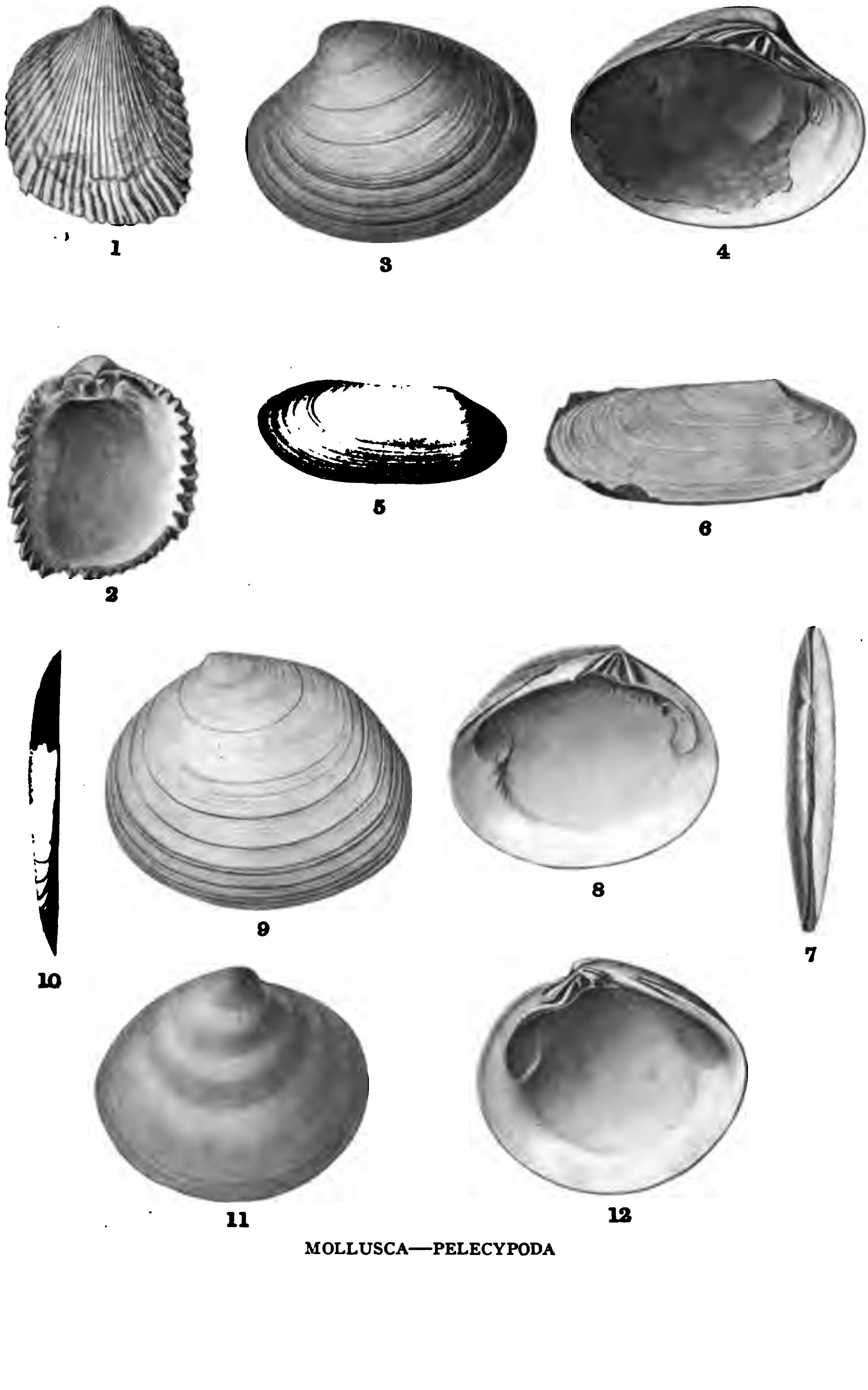
Figs. 1, 2. Cardium eufalense Conrad.................................. 664
1. Exterior of left valve.
2. Interior of same.
Monmouth formation, Brightseat, Prince George's County.

Figs. 3, 4. Antigona (Aphrodina) tippana (Conrad).................. 681
3. Exterior of left valve.
4. Interior of same.
Monmouth formation, Brightseat, Prince George's County.

Figs. 5-7. Legumen planulatum (Conrad) Gabb........................ 684
5. Exterior of right valve.
6. Double valves from right side.
7. Dorsal view of same.
Monmouth formation, Brightseat, Prince George's County.

Figs. 8-10. Cyprimeria depressa Conrad.............................. 687
8. Interior of left valve. Monmouth formation, Brightseat, Prince George's County.
9. Exterior of left valve.
10. Dorsal view of same.
Monmouth formation, near Oakland, Prince George's County.

Figs. 11, 12. Cyprimeria major Gardner n. sp.......................... 689
11. Exterior of right valve of young individual.
12. Interior of same.
Monmouth formation, Brightseat, Prince George's County.



MOLLUSCA—PELECYPODA

PLATE XLI

1

3

5

2

6

4

MOLLUSCA—PELECYPODA

PLATE XLII

PAGE

Fig. 1. CYPRIMERIA MAJOR Gardner n. sp. 689
Exterior of gerontic right valve. Monmouth formation, Brightseat, Prince George's County, U. S. National Museum.

Fig. 2. TELLINA (ACROPAGIA) GABBI Gardner n. sp. 694
Exterior of right valve. Monmouth formation, 1 mile west of Friendly, Prince George's County.

Figs. 3, 4. AENONA EUFALENSIS Conrad. 697
3. Exterior of left valve. × 2. Monmouth formation, Brightseat, Prince George's County.
4. Exterior of right valve. × 2. Monmouth formation, near Oakland, Prince George's County, U. S. National Museum.

Figs. 5, 6. TELLINIMERA EBOREA Conrad. 695
5. Exterior of right valve. × 2.
6. Dorsal view of double valves. × 2.
Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.

Figs. 7, 8. LEPTOSOLEN BIPLICATA Conrad. 703
7. Dorsal view of internal cast of double valves. Monmouth formation, 2 miles southwest of Oxon Hill, Prince George's County.
8. Exterior of right valve. × 2. Monmouth formation, Brightseat, Prince George's County.

2

3

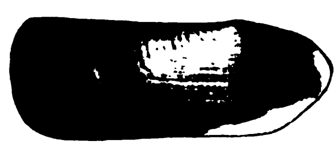
4

5

6

1

7



8

MOLLUSCA—PELECYPODA

PLATE XLIII

PAGE

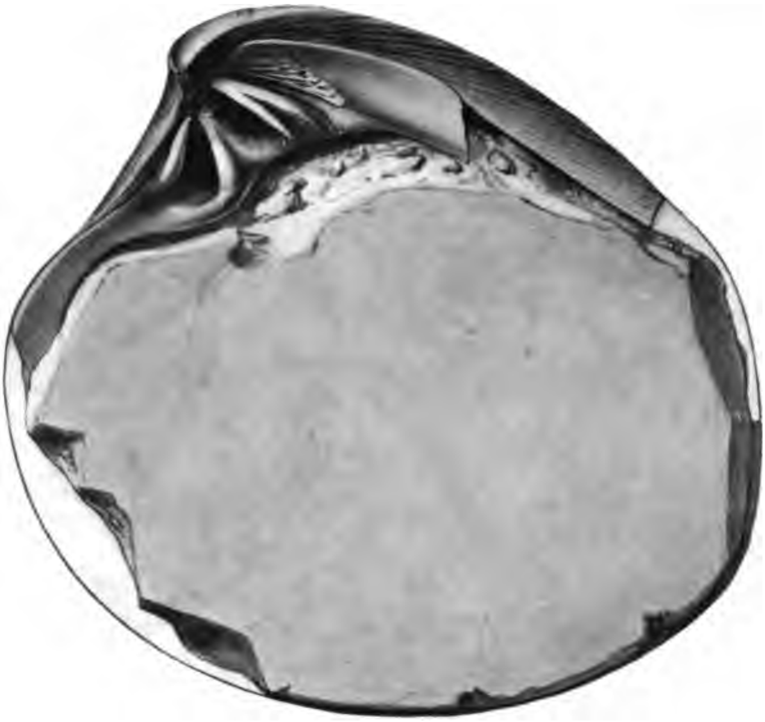
Fig. 1. CYPRIMERIA MAJOR Gardner n. sp. 689
Hinge of gerontic right valve. Monmouth formation, Brightseat, Prince George's County, U. S. National Museum.

Figs. 2, 3. SPISULA (CYMBOPHORA) BERRYI Gardner n. sp. 708
2. Exterior of right valve. × 2.
3. Dorsal view of double valves. × 2.
Monmouth formation, Brightseat, Prince George's County.

Figs. 4, 5. SPISULA (CYMBOPHORA) WORDENI Gardner n. sp. 709
4. Interior of left valve.
5. Exterior of same.
Monmouth formation, Brightseat, Prince George's County.

Figs. 6, 7. CORBULA CRASSIPLICA Gabb 713
6. Exterior of right valve. × 5.
7. Double valves from left side. × 5.
Monmouth formation, 1 mile west of Friendly, Prince George's County.

Figs. 8-10. CORBULA TERRAMARIA Gardner n. sp. 716
8. Exterior of right valve. × 3.
9. Interior of same. × 3.
10. Double valves from left side. × 3.
Monmouth formation, Brightseat, Prince George's County.

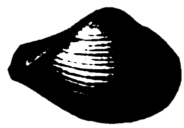


1

6

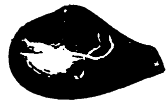
7

2



8

4



10

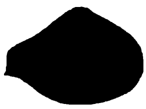
3

9

5

MOLLUSCA—PELECYPODA

PLATE XLIV


1


2


4


3


8


5


13


6

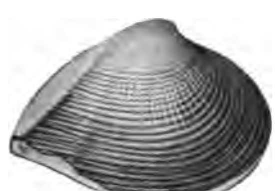

7


14


9


10


15


11


12

MOLLUSCA—PELECYPODA

PLATE XLV

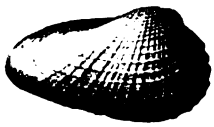
PAGE

Fig. 1. PHOLAS PECTOROSA Conrad 724
Exterior of right valve. Monmouth formation, Brightseat, Prince George's County.

Fig. 2. PANOPE BONASPES Gardner n. sp. 723
Internal cast of left valve. Magothy formation, Good Hope Hill near Anacostia, D. C.

Fig. 3. TEREDO RHOMBICA Gardner n. sp. 732
Exterior of imperfect right valve. Monmouth formation, Brightseat, Prince George's County.

Figs. 4, 5. PANOPE MONMOUTHENSIS Gardner n. sp. 722
4. Exterior of right valve.
5. Hinge of right valve.
Monmouth formation, Brightseat, Prince George's County.


1


2


4


3


5

MOLLUSCA—PELECYPODA

PLATE XLVI

Unless otherwise specified all the specimens illustrated on this plate are from the Vincentown limesand of New Jersey.

PAGE

Figs. 1, 2. CRIBRILINA SAGENA (Morton) 742
1. A characteristic zoarium. × 2.
2. Surface of a zoarium, much enlarged. (After Gabb and Horn.)

Fig. 3. MEMBRANIPORA ANNULOIDEA Ulrich and Bassler 740
Surface of a zoarium. × 24.

Fig. 4. MEMBRANIPORELLA ABBOTTI (Gabb and Horn) 743
Surface of zoarium, much enlarged. (After Gabb and Horn.)

Figs. 5, 6. AMPHIBLESTRUM HETEROPORA (Gabb and Horn) 740
5. Portion of a zoarium. × 20.
6. A single zoœcium, more enlarged.
Eocene (Aquia) Upper Marlboro, Md. (After Ulrich.)

Fig. 7. ESCHARINELLA ? ALTIMURALIS Ulrich and Bassler 741
A number of zoœcia. × 20.

Figs. 8, 9. MUCRONELLA ASPERA Ulrich 743
Two views showing zoœcial characters. × 20. Eocene (Aquia) Upper Marlboro, Md.

Fig. 10. STOMATOPORA KÜMMELI Ulrich and Bassler 737
View of a portion of the type specimen. × 12.

Fig. 11. STOMATOPORA REGULARIS Gabb and Horn 736
Portion of a zoarium. × 6. Incrusting another bryozoan.

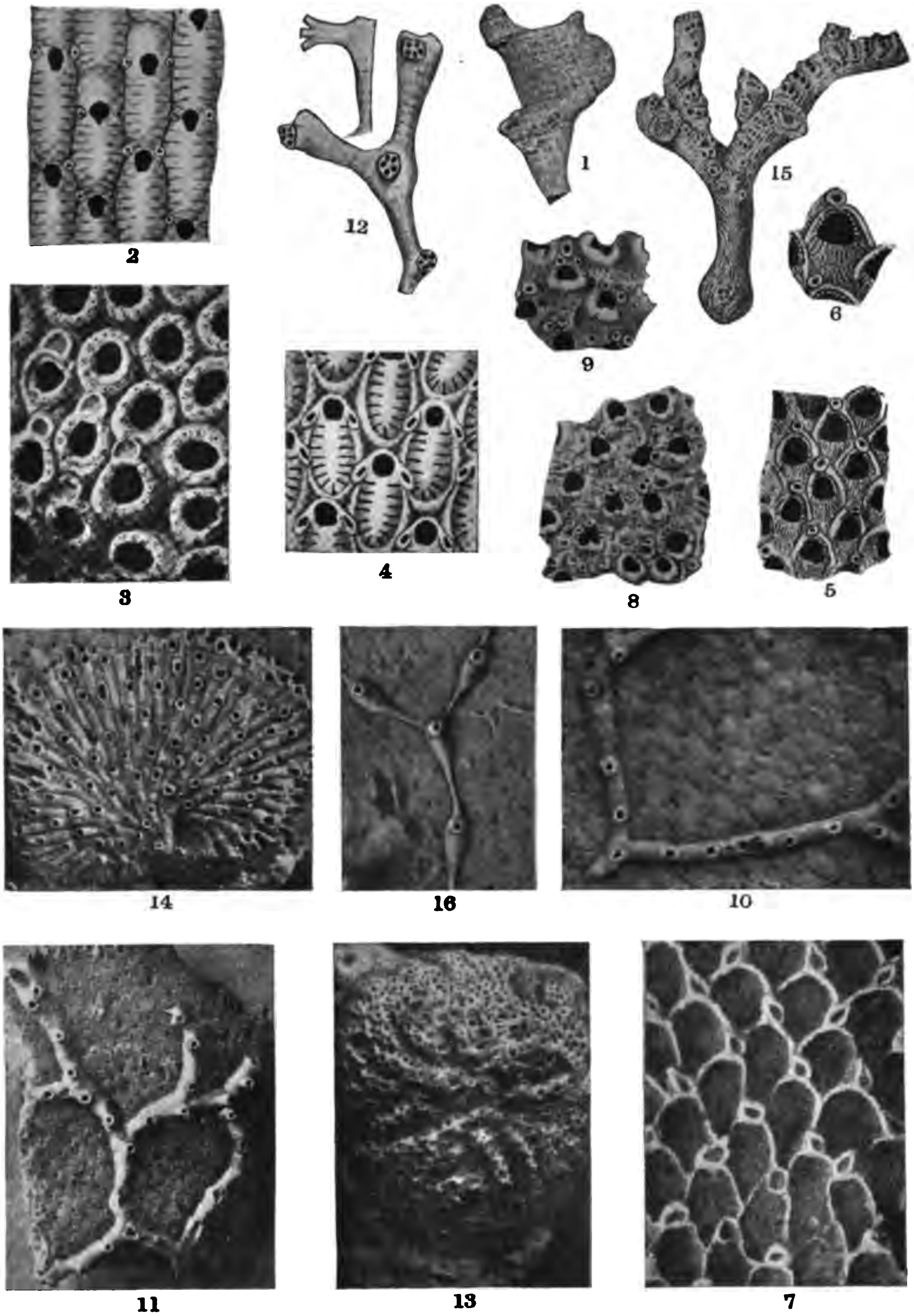
Fig. 12. FILIFASCIGERA MEGÆRA (Lonsdale) 739
Front and side views of part of a zoarium. × 12.

Fig. 13. LICHENOPORA PAYRACEA (D'Orbigny) 739
A complete zoarium. × 12.

Fig. 14. BERENICEA AMERICANA (Ulrich and Bassler) 737
View of the type specimen. × 12.

Fig. 15. CRISINA STRIATOPORA Ulrich and Bassler 738
The type specimen. × 12. Miocene of Maryland.

Fig. 16. HIPPOTHOA TENUICHORDA (Ulrich and Bassler) 745
Several zoœcia of the type example. × 20.



MOLLUSCOIDEA—BRYOZOA

PLATE XLVII

PAGE

Figs. 1-5. TEREBRATULA HARLANI Morton 734

1. Exterior of dorsal valve.
2. Interior of ventral valve.
3. Exterior of same.
4. Ventral view of complete individual.
5. Dorsal view of same.

Rancocas formation, Noxontown Pond, Delaware.

Figs. 6-10. CARDIASTER MARYLANDICA Clark n. sp. 750

6. Oral view.
7. Aboral view of same.
8. Aboral view of another specimen.
9. Oral view of same.
10. Lateral view of same.

Monmouth formation, Brightseat, Prince George's County.

Figs. 11-14. HEMIASTER DELAWARENSIS Clark n. sp. 751

11. Aboral view.
12. Lateral view of same.
13. Oral view of same.
14. Posterior view of same.

Matawan formation, south side of Chesapeake and Delaware Canal, between Lorewood Grove and St. Georges, Delaware.

Fig. 15. SERPULA TRIGONALIS Gardner n. sp. 746

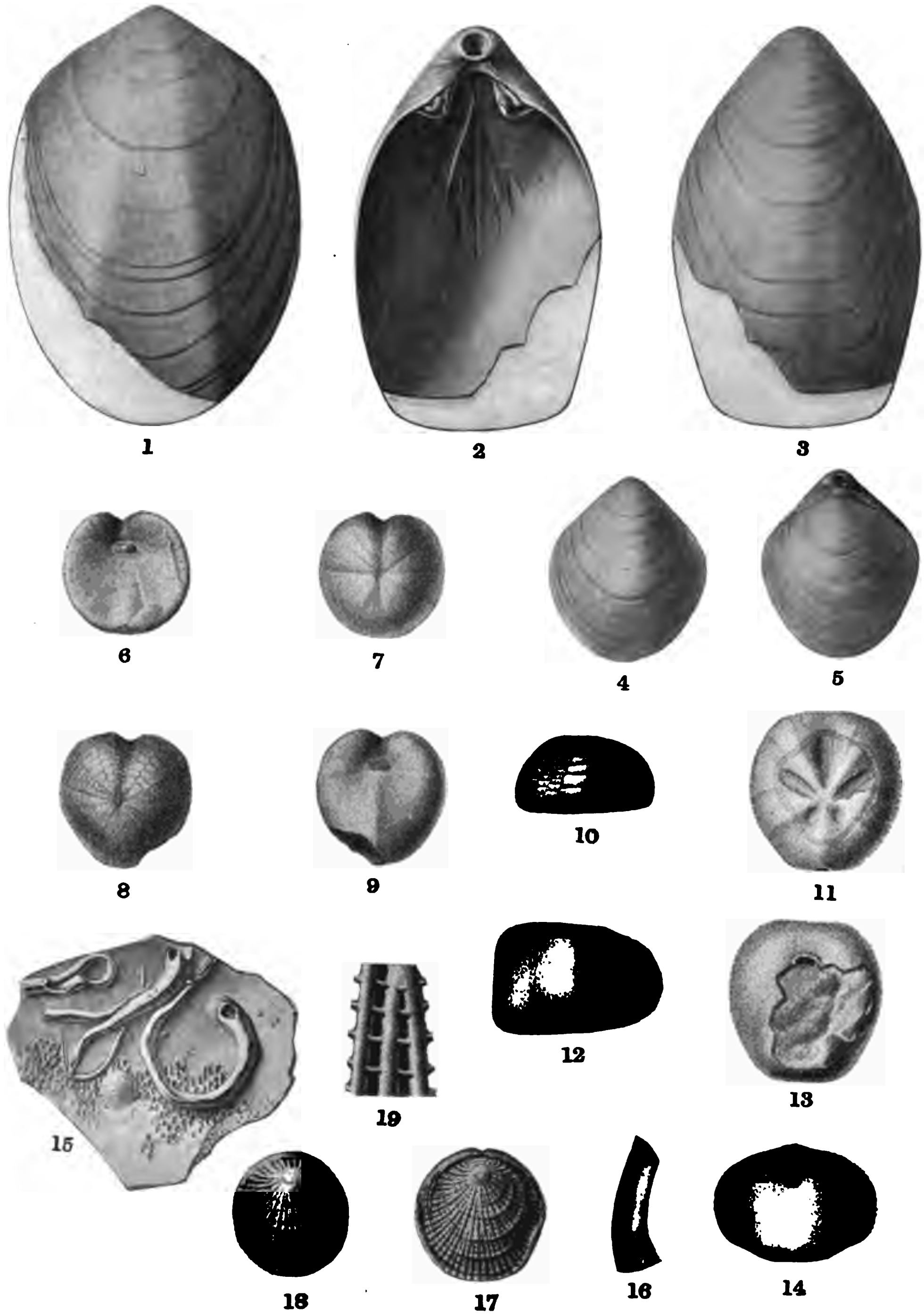
Type $\times$ 2.

Rancocas formation, Noxontown Pond, Delaware.

Figs. 16-19. ORNATAPORTA MARYLANDICA Gardner n. gen. et sp. 748

16. Lateral view of tube.
17. Operculum of same. $\times$ 4.
18. Operculum of another specimen. $\times$ 4.
19. Several radials. $\times$ 20.

Monmouth formation, Brooks' Estate near Seat Pleasant, Prince George's County.



MOLLUSCOIDEA—BRACHIOPODA, VERMES AND ECHINODERMATA

PLATE XLVIII

1. Calicular view of a typical specimen (× 4) from near Brightseat, Md. The interseptal loculi are filled with matrix which obscures the grouping of the septa, and which cannot be removed without injury to the specimen. Collection of the Maryland Geological Survey, on deposit in the U. S. National Museum.
2. Side view of the specimen shown in the preceding figure. × 8. The septal denticulations which are partly obscured by the matrix have been partly restored by retouching.
3. Interior view of a typical specimen (× 8) from near Brightseat, Md., showing the spongy columella, the synapticulæ, tubercles, and striæ on the sides of the septa, and the intercostal synapticulæ and perforations of the base.
4. View of the base of the type (× 8) showing the character and grouping of the costæ.

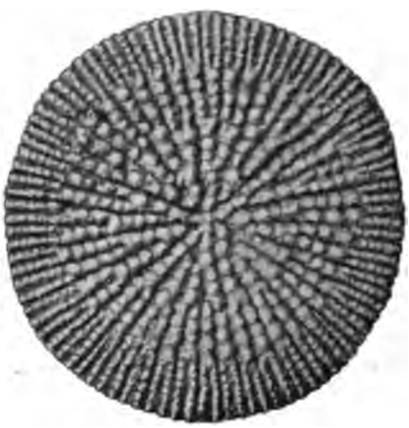
5. Side view of the type (× 8) from near Brightseat, Md., showing the costæ, tubercles, and broken edge of the wall, and the uncovered edges of some of the septa. Collection of the Maryland Geological Survey, on deposit in the U. S. National Museum.
6. Calicular view of the type (× 8), showing the arrangement of the septa and the spongy character of the columella.


1


2


3


6

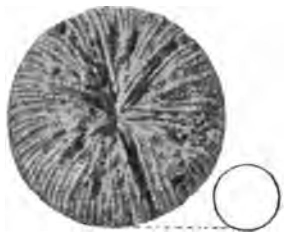

4


5

CŒLENTERATA—ANTHOZOA

PLATE XLIX

1. Calicular view of the type ($\times$ 4) from near Brightseat, Md. The interseptal loculi are filled with matrix which cannot be removed without injury to the specimen; the grouping of the septa is therefore not clearly apparent. Collection of the Maryland Geological Survey, on deposit in the U. S. National Museum.
2. Side view of the type. $\times$ 8. The septal denticulations are partly obscured by the matrix and have been partly restored by retouching.
3. Interior view of the type ($\times$ 8), which is broken nearly directly through the center, showing the spongy columella, the synapticulæ, tubercles, and striæ of the sides of the septa, and the intercostal synapticulæ and perforations of the base.
4. View of the base of the type ($\times$ 8) from near Brightseat, Md., showing the character and grouping of the costæ.



1

2

3

4

CŒLENTERATA—ANTHOZOA

PLATE L

PAGE

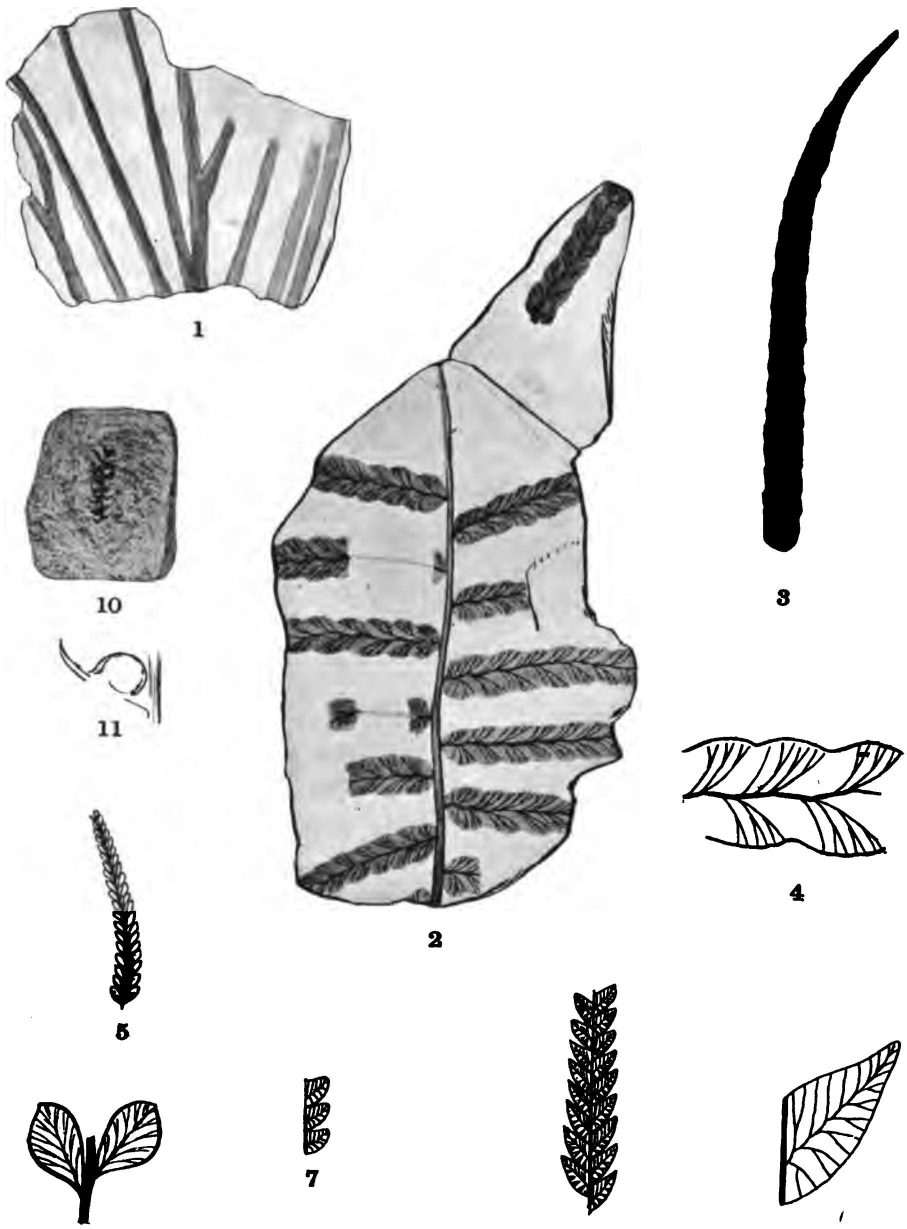
Fig. 1. ALGITES AMERICANA Berry 758
Magothy formation, Round Bay.

Figs. 2-4. OSMUNDA DELAWARENSIS Berry 763
2, 3. Portions of a frond.
4. Enlargement to show details of venation. × 3.
Magothy formation, Deep Cut, Del.

Figs. 5, 6. GLEICHENIA DELAWARENSIS Berry 762
5. A pinna.
6. Pinnules enlarged to show venation. × 4.
Magothy formation, Deep Cut, Del.

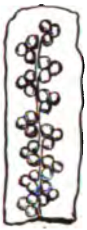
Figs. 7-9. GLEICHENIA SAUNDERSI Berry 762
7, 8. Portions of pinnæ.
9. Pinnule showing venation. × 5.
Magothy formation, Round Bay.

Figs. 10, 11. LYCOPODIUM CRETACEUM Berry 759
10. Portion of strobilus.
11. Drawing of single sporophyll from left side of preceding, showing scale and outline of the sporangium. × 8.
Magothy formation, Little Round Bay.



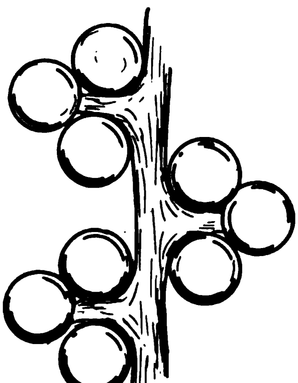
THALLOPHYTA AND PTERIDOPHYTA

PLATE LI

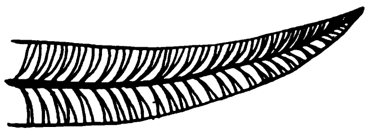


1

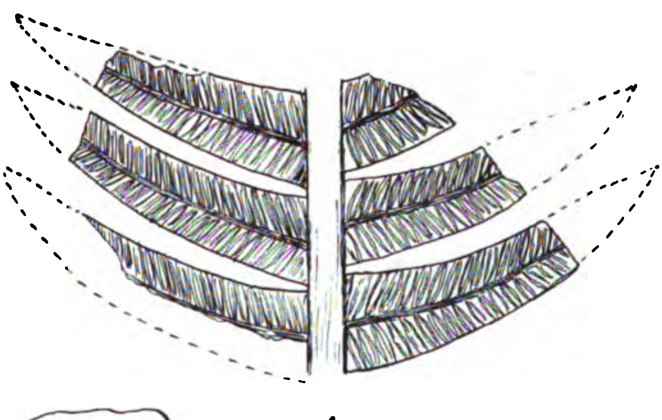
5



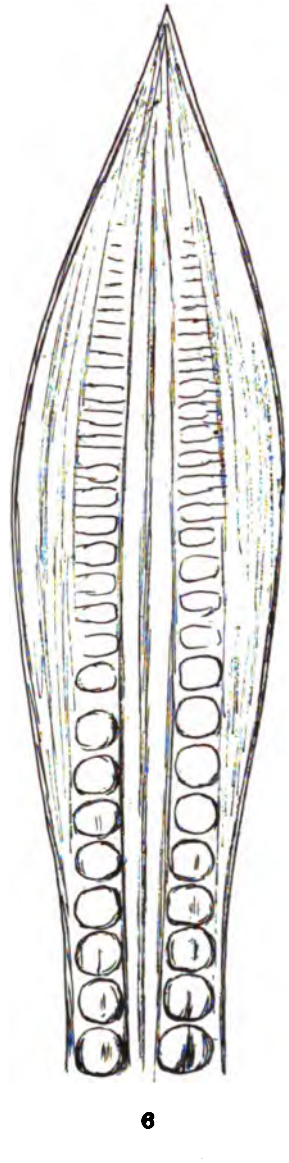
2



3



4



6

7

8

PTERIDOPHYTA AND CYCADOPHYTA

PLATE LII

PAGE

Fig. 1. BRACHYPHYLLUM MACROCARPUM Newberry...................... 782

From Raritan formation at South Amboy, New Jersey. (After Hollick and Jeffrey.)

Fig. 2. BRACHYPHYLLUM MAMILLARE Brongniart........................ 782

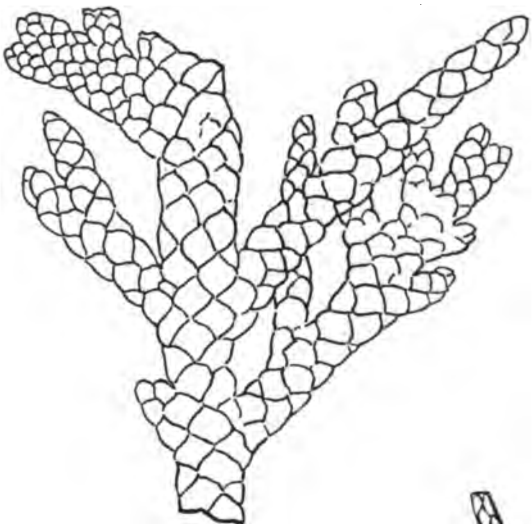
A specimen of this species which is the type of the genus, from the Jurassic of France. (After Saporta.)

Fig. 3. BRACHYPHYLLUM OBESUM Heer................................ 782

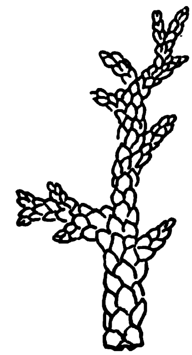
From the Aptian of Portugal. (After Saporta.)

Figs. 4, 5. BRACHYPHYLLUM PARCERAMOSUM Fontaine.................. 782

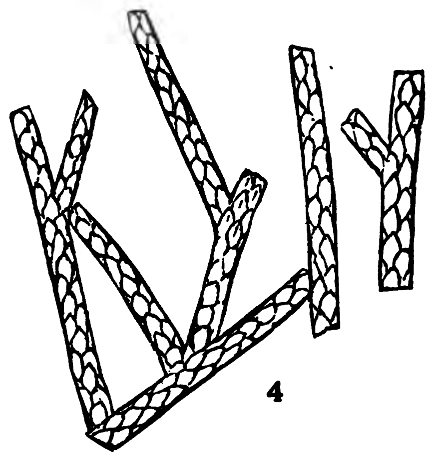
4. Telegraph Station, Virginia. (After Fontaine.)
5. From the Trinity of Texas. (After Fontaine.)



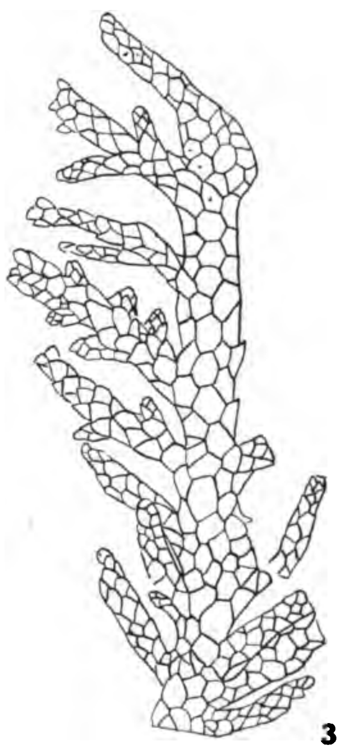
1



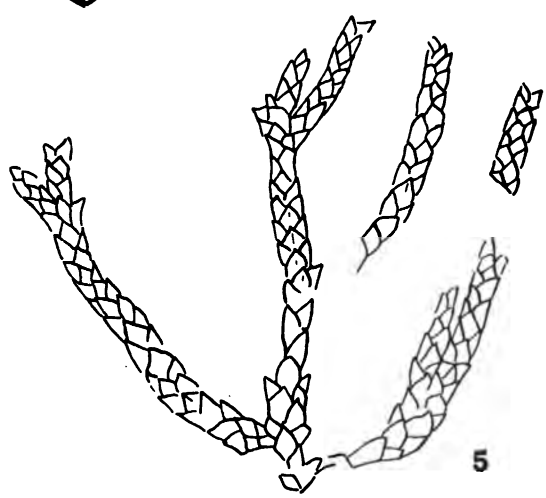
2



4



3



5

CONIFEROPHYTA

PLATE LIII

2

1

CONIFEROPHYTA

PLATE LIV

		PAGE
Fig. 1.	Araucaria bladenensis Berry Magothy formation, Grove Point.	777
Fig. 2.	Araucaria marylandica Berry Magothy formation, Little Round Bay.	779
Fig. 3.	Dammara cliffwoodensis Hollick Matawan formation near Millersville.	776
Figs. 4, 5.	Brachyphyllum macrocarpum Newberry Magothy formation, Deep Cut, Delaware.	781
Fig. 6.	Geinitzia formosa Heer Magothy formation, Deep Cut, Delaware.	801
Fig. 7.	Sequoia heterophylla Velenovsky (After Newberry.)	785

CONIFEROPHYTA

PLATE LV

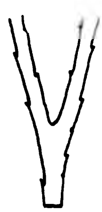
PAGE

Fig. 1. Widdringtonites reichi (Ettingshausen) Heer 793
(After Newberry.)

Figs. 2, 3. Rabitania gracilis (Newberry) Hollick and Jeffrey 800
2. Twigs, natural size. (After Newberry.)
3. Twig enlarged to show minute leaves. × 3.

1

2

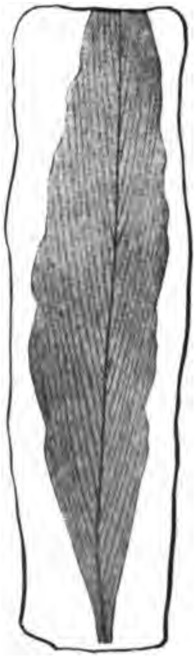


3

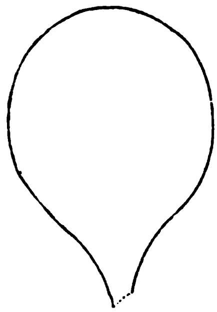
CONIFEROPHYTA

PLATE LVI

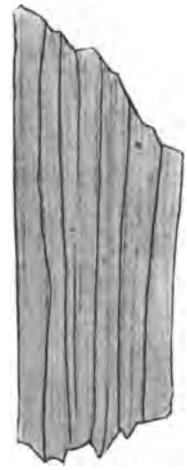
1



2

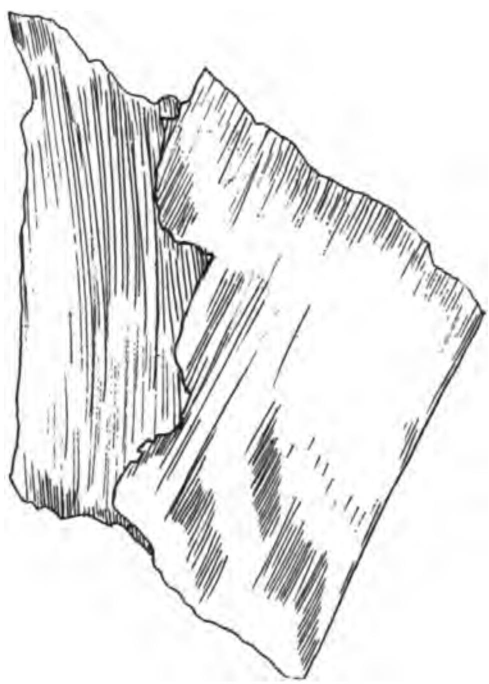


3



4

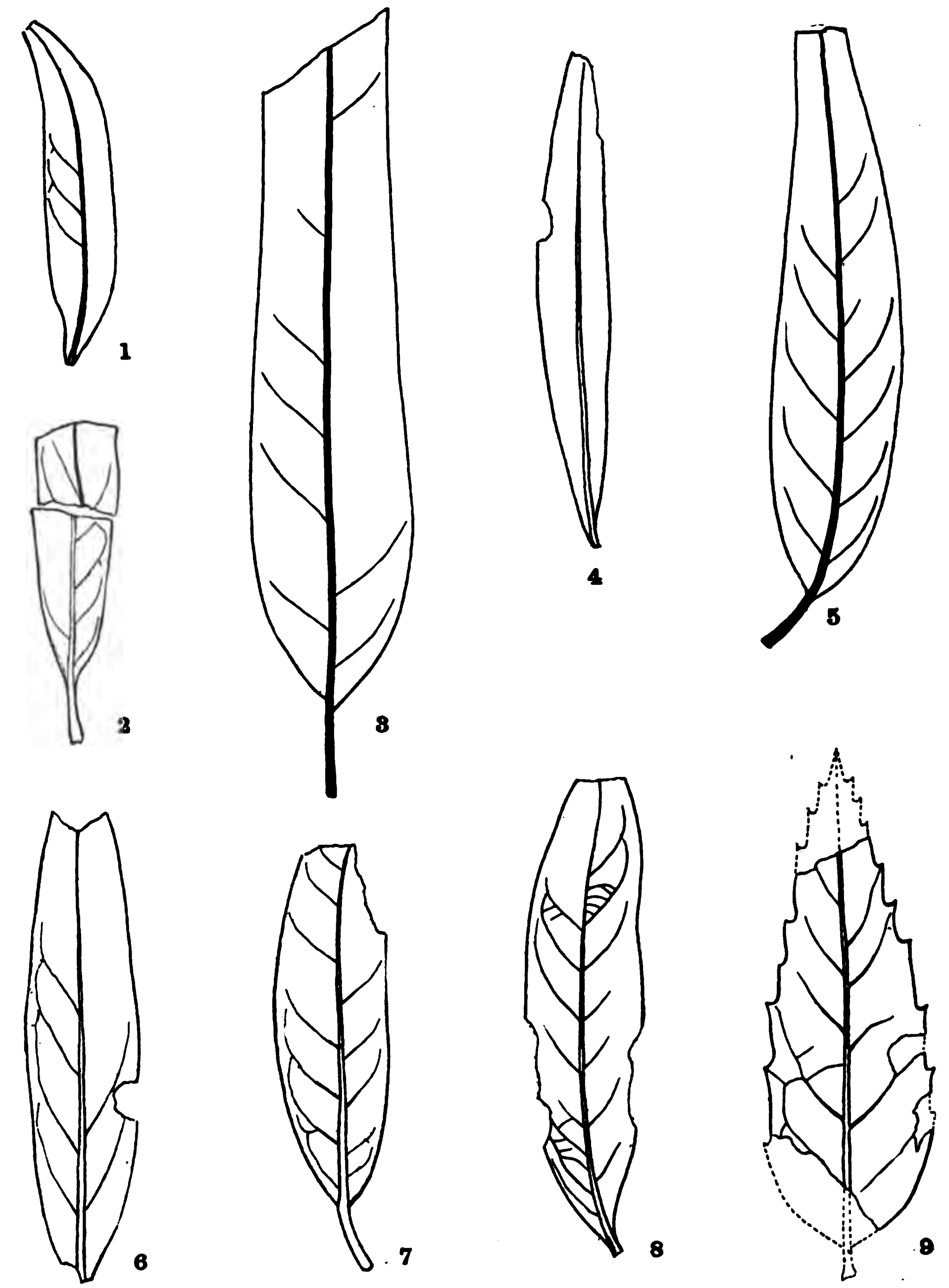
5



6

CONIFEROPHYTA AND ANGIOSPERMOPHYTA

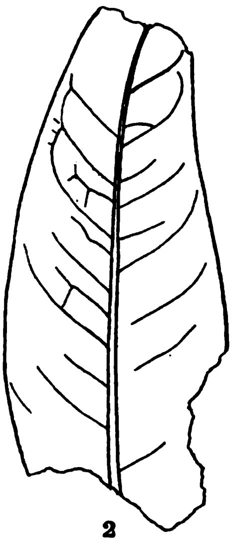
PLATE LVII



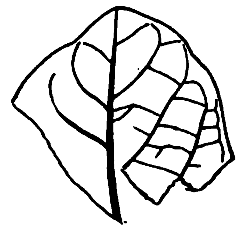
ANGIOSPERMOPHYTA

PLATE LVIII

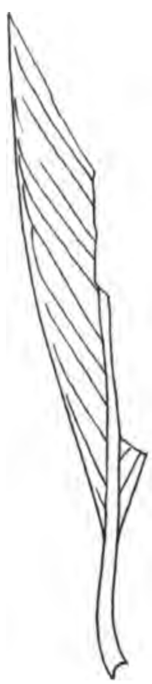
		PAGE
Fig. 1.	POPULUS STYGIA Heer Magothy formation, Bodkin Point.	816
Fig. 2.	QUERCUS MORRISONIANA Lesquereux Magothy formation, Round Bay.	816
Fig. 3.	FICUS DAPHNOGENOIDES (Heer) Berry Magothy formation, Grove Point.	818
Fig. 4.	FICUS CECILENSIS Berry Magothy formation, Grove Point.	821
Fig. 5.	FICUS CRASSIPES (Heer) Heer Magothy formation, Deep Cut, Del.	821



2

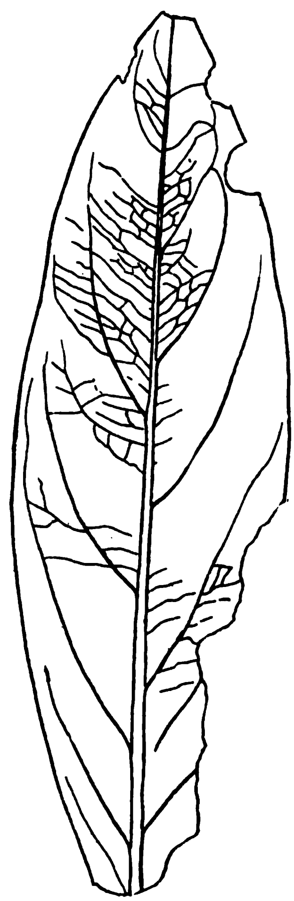


1



5

3



4

ANGIOSPERMOPHYTA

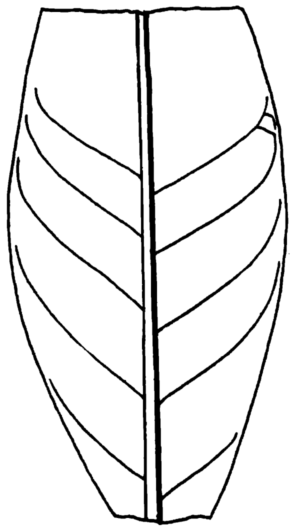
PLATE LIX

PAGE

Fig. 1. FICUS KRAUSIANA Heer.. 823
Magothy formation, Grove Point.

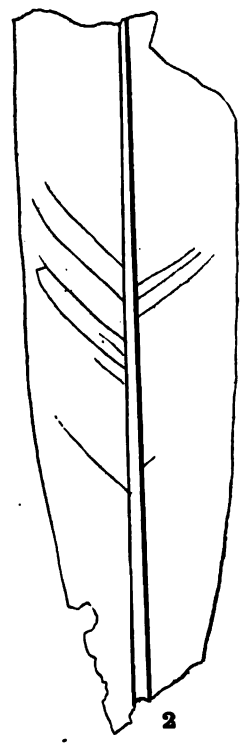
Figs. 2, 3. FICUS CRASSIPES (Heer) Heer.............................. 821
Magothy formation, Grove Point.

Fig. 4. FICUS OVATIFOLIA Berry....................................... 820
Raritan formation, East Washington Heights, D. C.

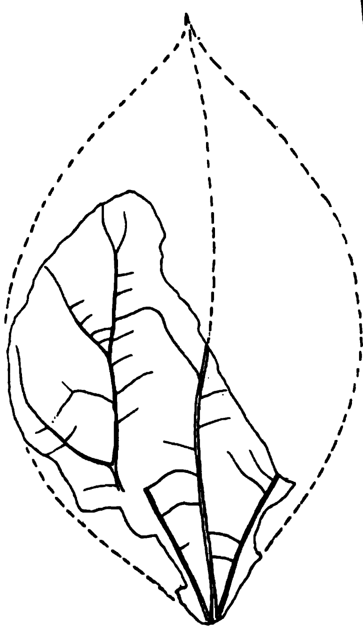


1

3



2



4

ANGIOSPERMOPHYTA

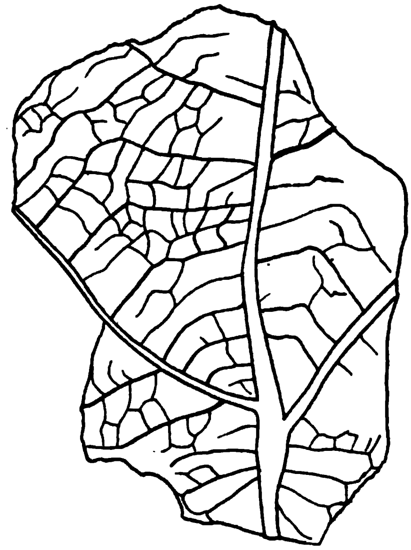
PLATE LX

PAGE

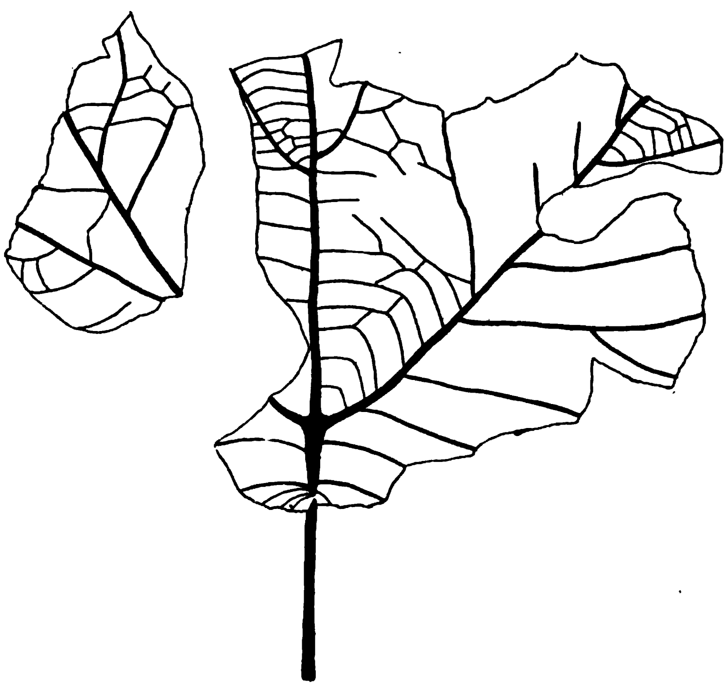
Figs. 1, 2. ASPIDIOPHYLLUM TRILOBATUM Lesquereux.................... 826

1. East Washington Heights, D. C.
2. Shannon Hill, Cecil County.

Raritan formation.



1



2

ANGIOSPERMOPHYTA

PLATE LXI

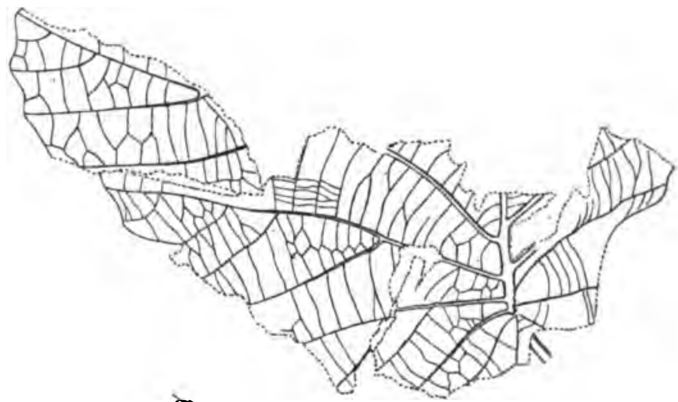
PAGE

Figs. 1, 2. ASPIDIOPHYLLUM TRILOBATUM **Lesquereux.................... 826**

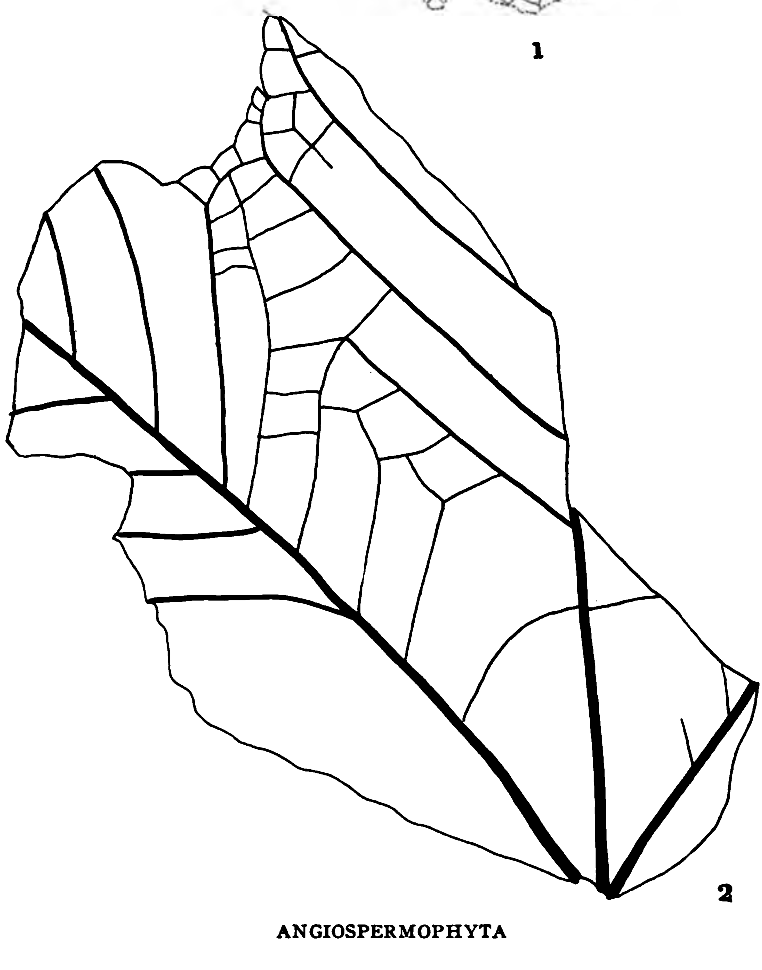
1. Forked Creek, Severn River.

2. Shannon Hill, Cecil County.

Raritan formation.



1

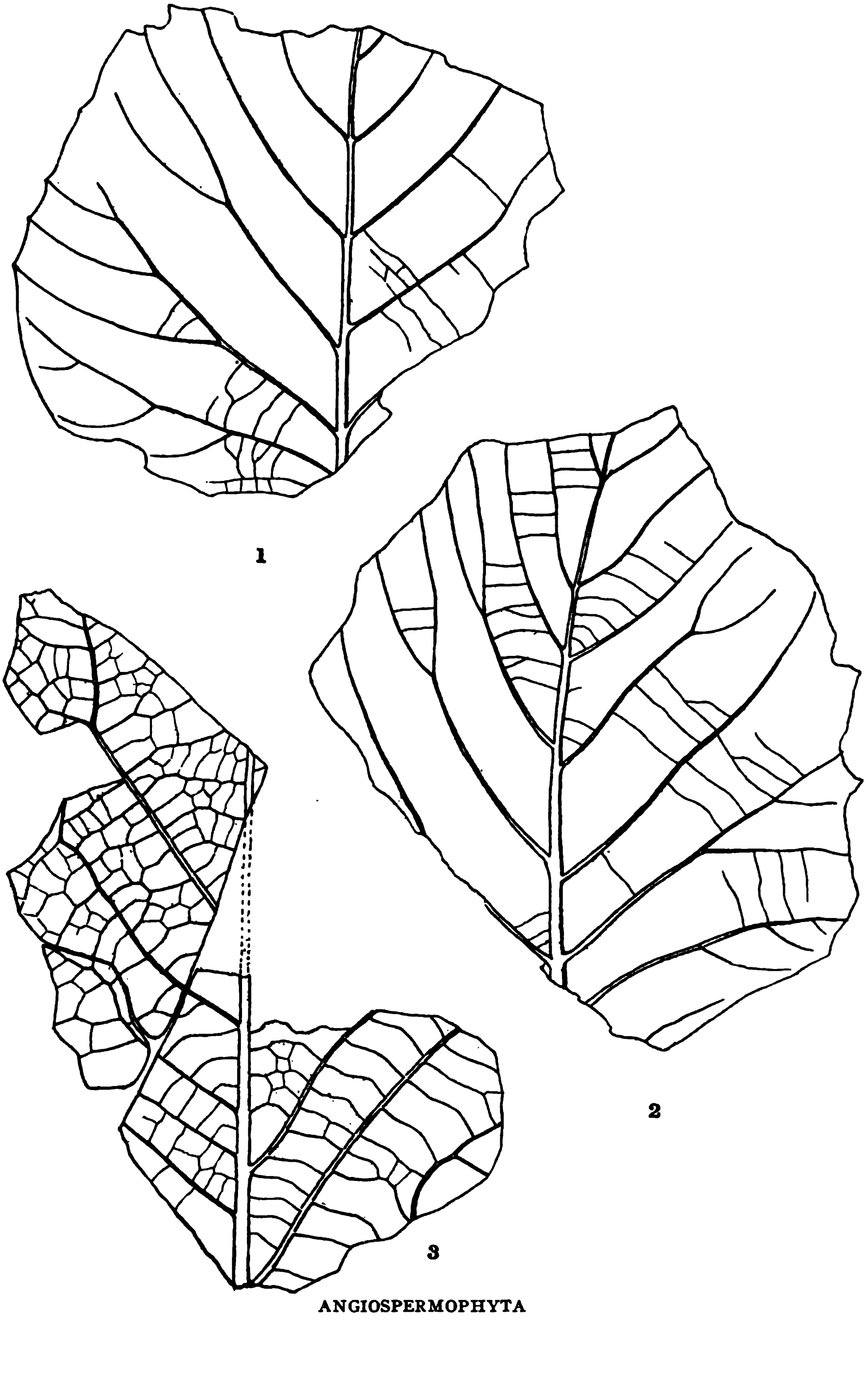


2

ANGIOSPERMOPHYTA

PLATE LXII

		PAGE
Figs. 1-3.	PROTOPHYLLUM STERNBERGII Lesquereux	828
	Raritan formation, East Washington Heights, D. C.	



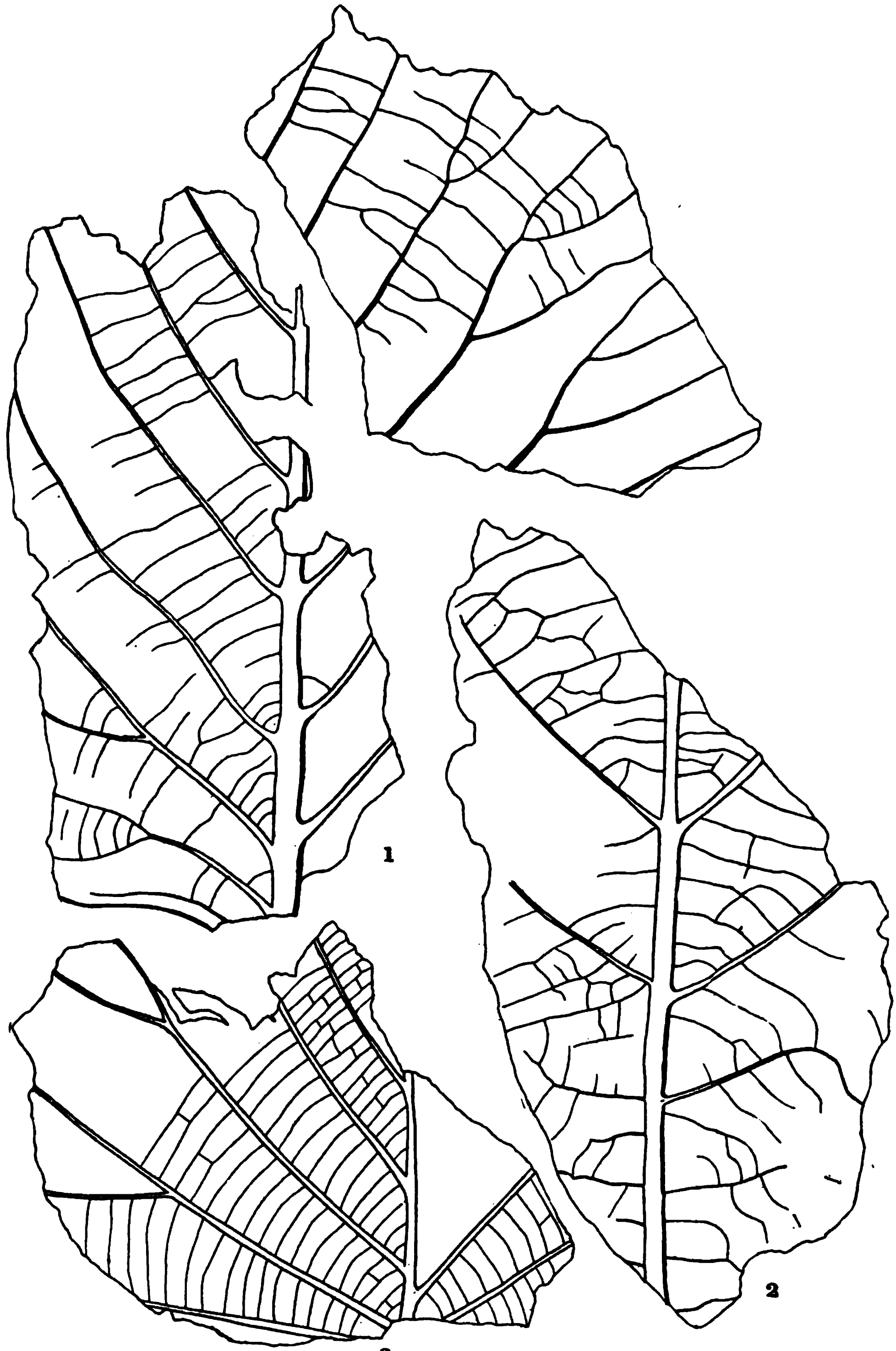
1

2

3

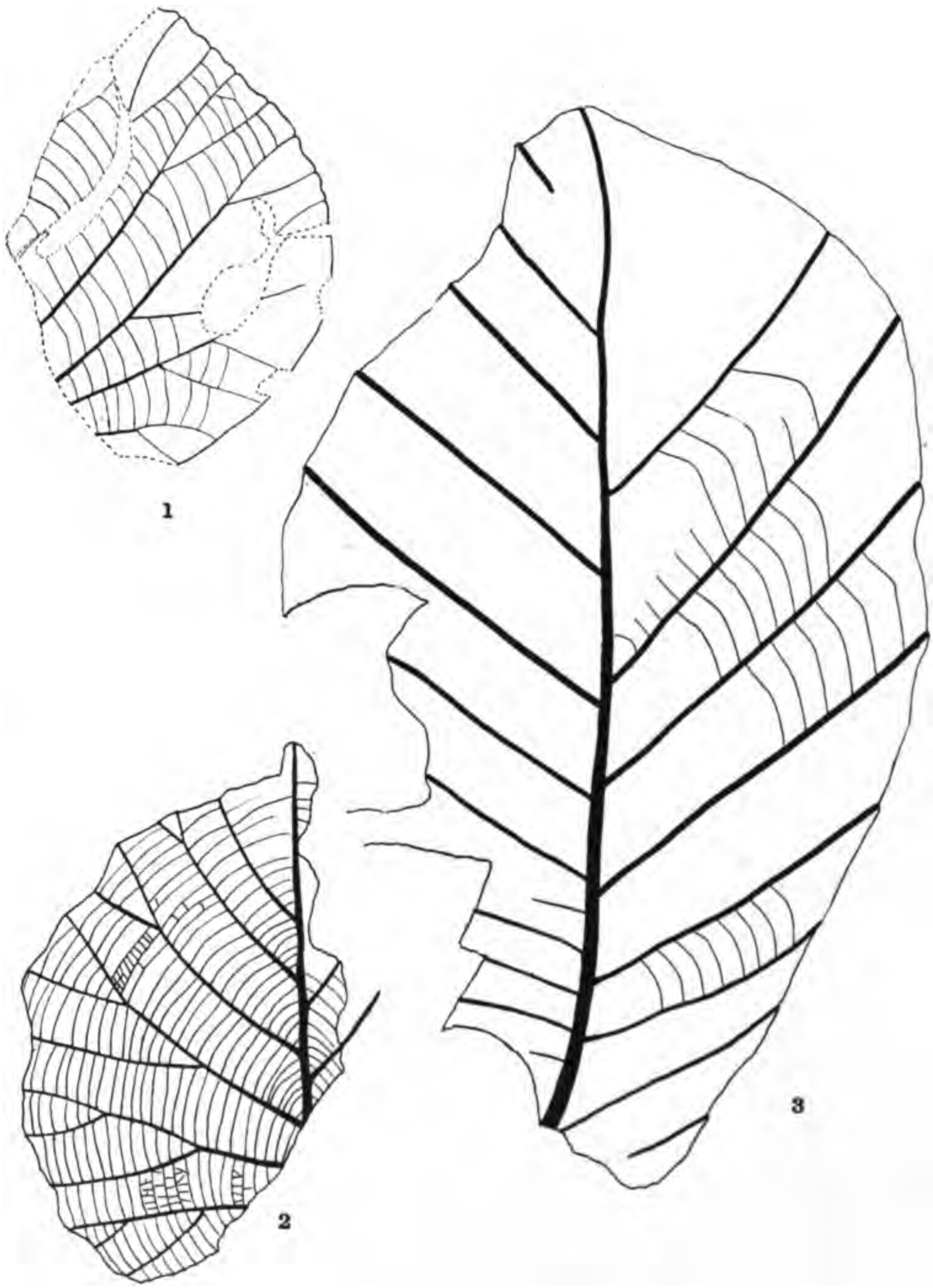
ANGIOSPERMOPHYTA

PLATE LXIII



 ANGIOSPERMOPHYTA

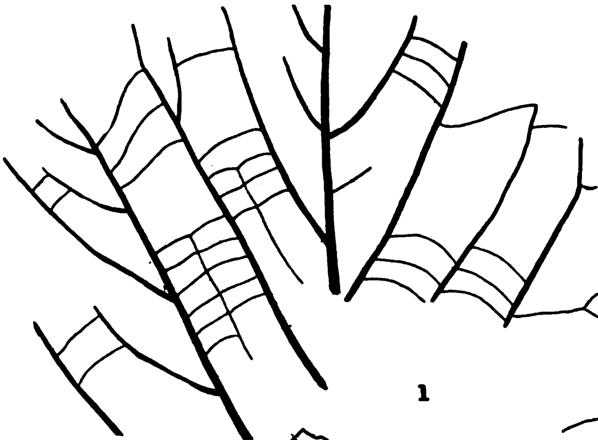
PLATE LXIV



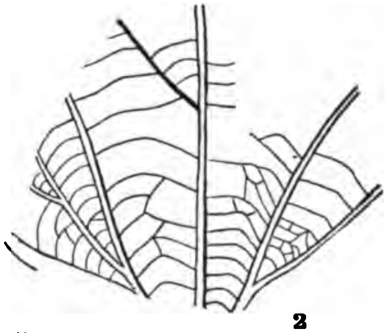
ANGIOSPERMOPHYTA

PLATE LXV

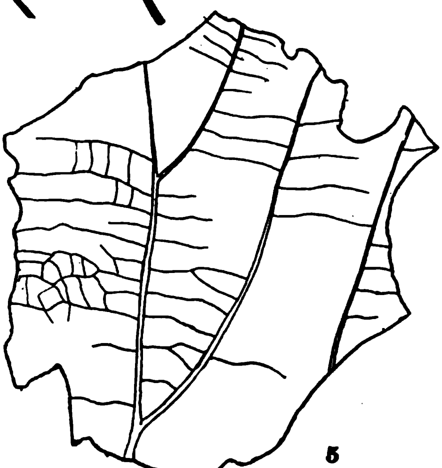
		PAGE
Figs. 1-6.	PLATANUS HEERII Lesquereux	824
	1-4. Drum Point R. R., Anne Arundel County.	
	5, 6. East Washington Heights, D. C.	
	Raritan formation.	



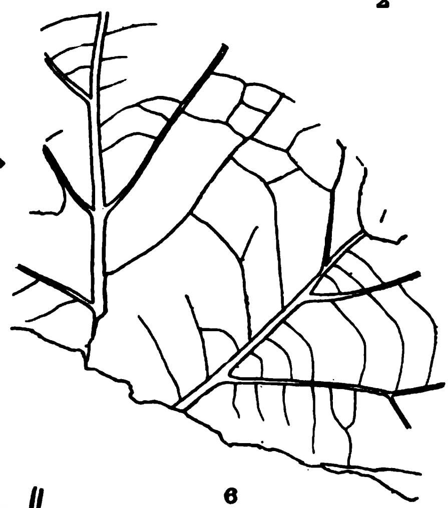
1



2



5



6

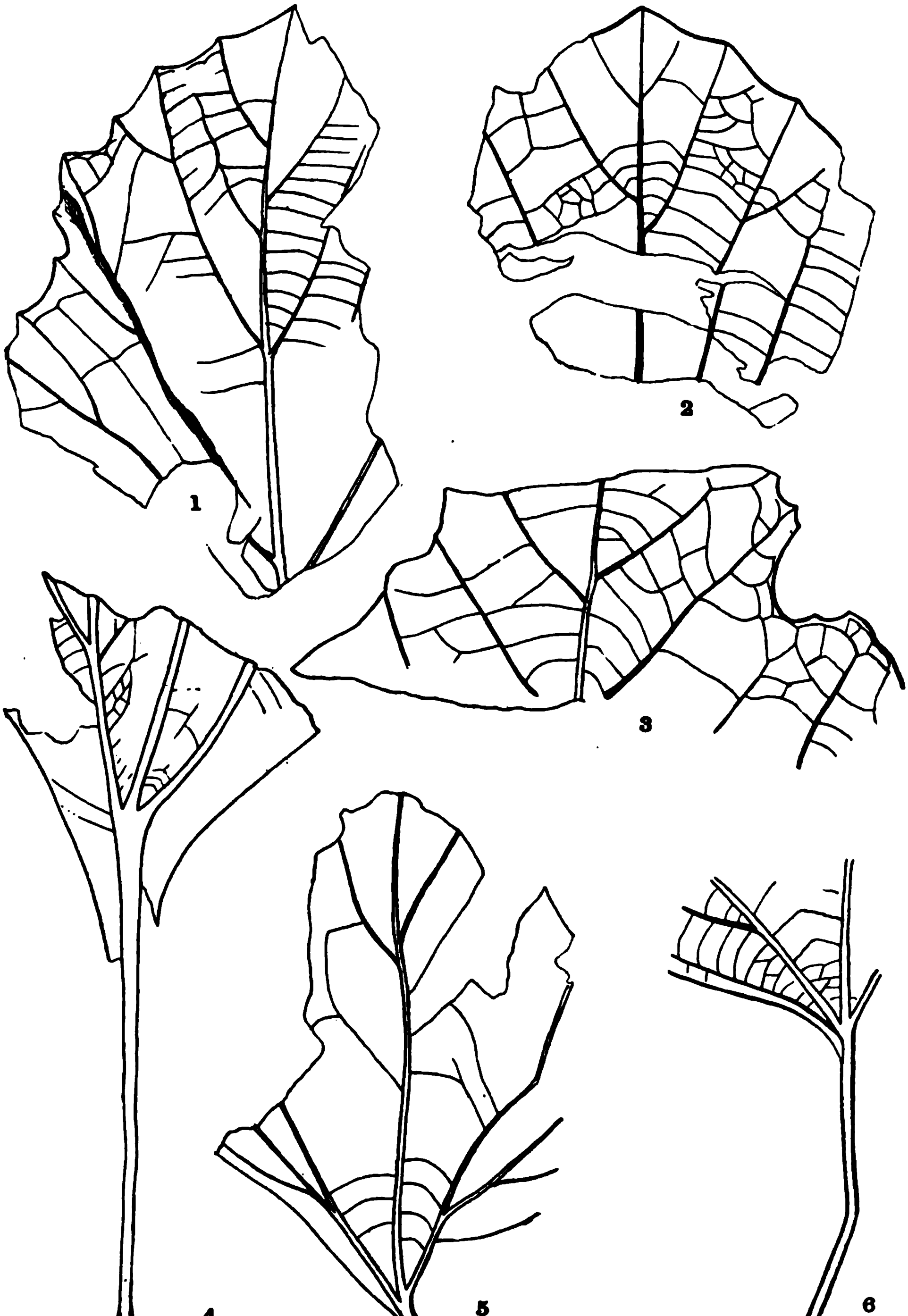
3

4

ANGIOSPERMOPHYTA

PLATE LXVI

		PAGE
Figs. 1-6.	PLATANUS HEERII Lesquereux................................	824
	Raritan formation, Drum Point R. R., Anne Arundel County.	

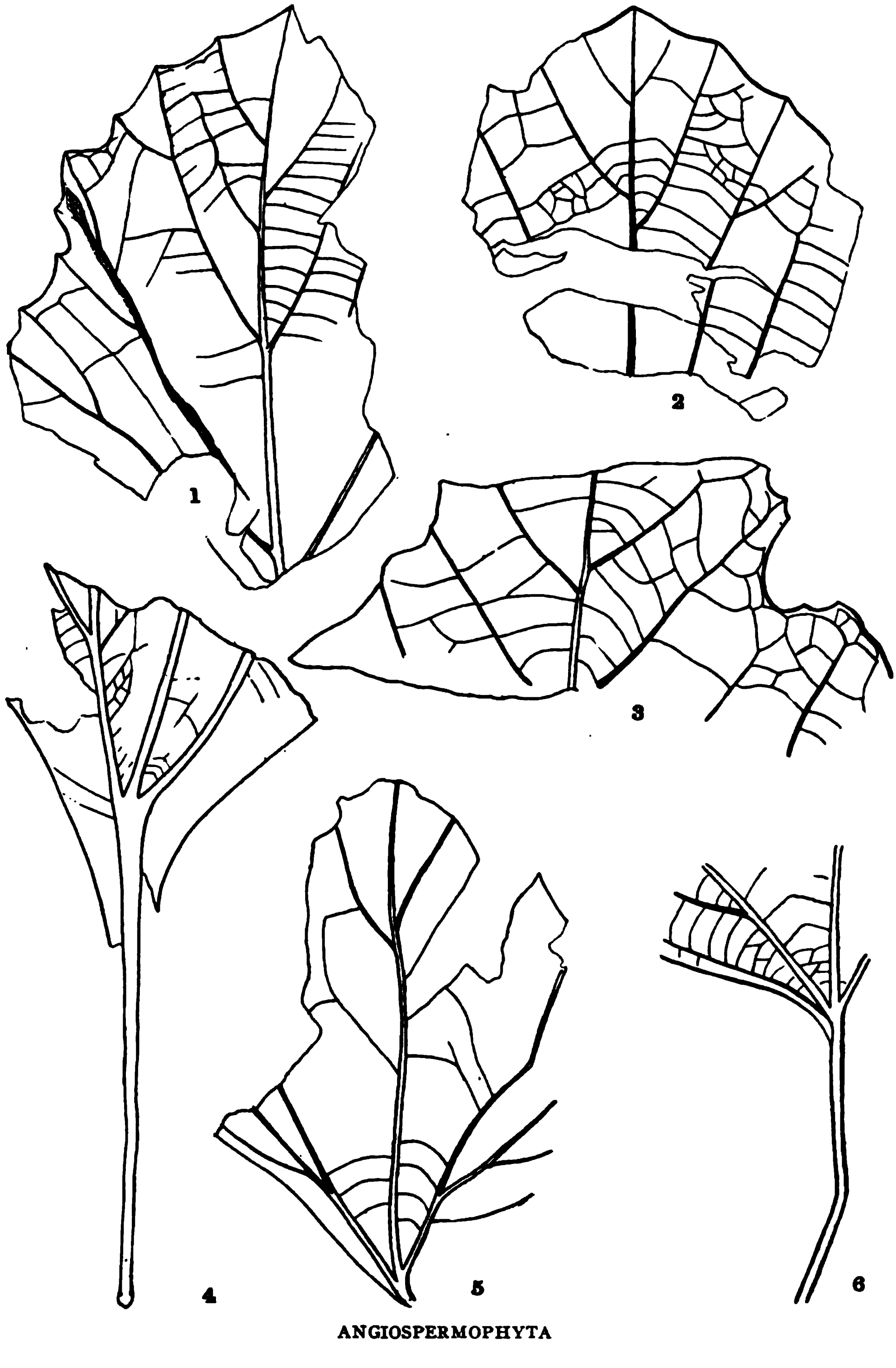


ANGIOSPERMOPHYTA

PLATE LXVI

PAGE

Figs. 1-6. Platanus heerii Lesquereux.............................. 824
Raritan formation, Drum Point R. R., Anne Arundel County.



ANGIOSPERMOPHYTA

PLATE LXVII

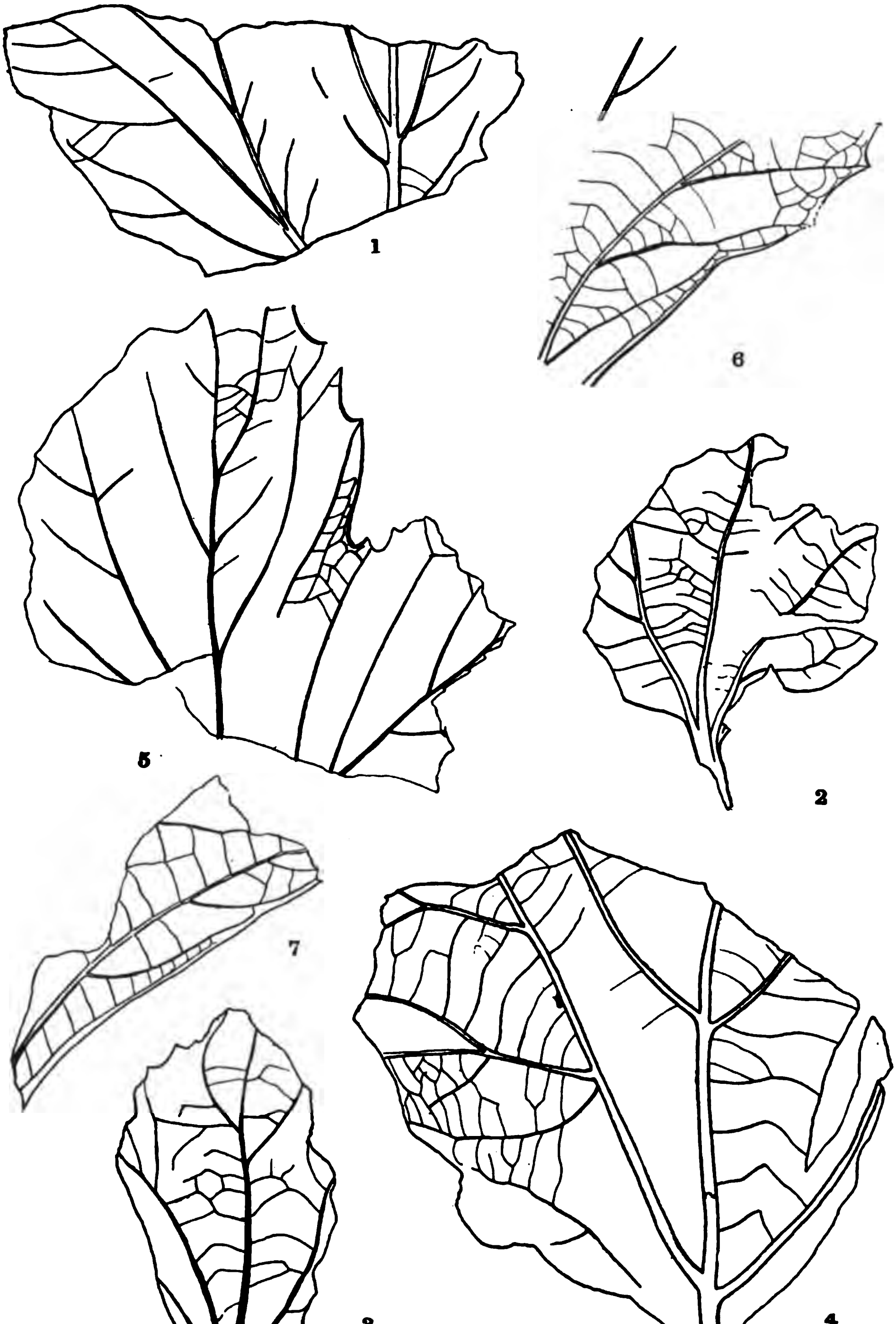
PAGE

Figs. 1-7. PLATANUS HEERII Lesquereux.................................. 824

1-4. East Washington Heights, D. C.

5, 7. Drum Point R. R., Anne Arundel County.

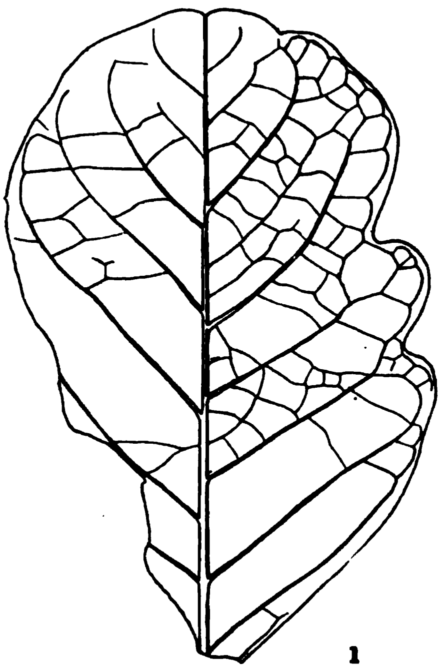
Raritan formation.



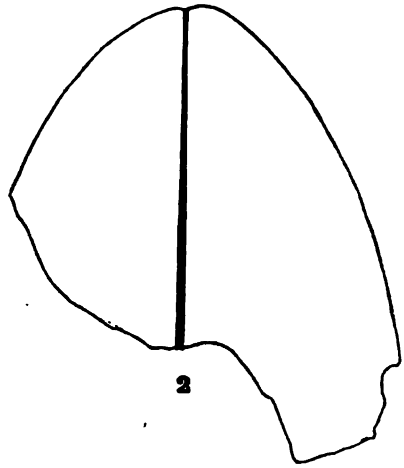
ANGIOSPERMOPHYTA

PLATE LXVIII

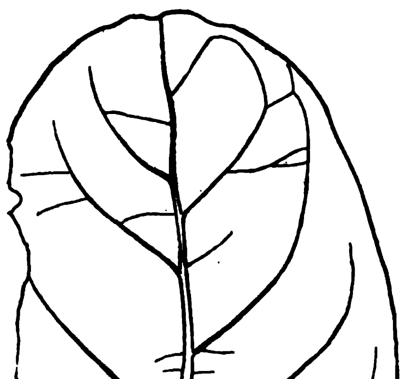
		PAGE
Fig. 1.	COCCOLOBITES CRETACEUS Berry..................................	830
	Magothy formation, Grove Point.	
Figs. 2-4.	MAGNOLIA OBTUSATA Heer....................................	834
	Magothy formation, Point Grove.	



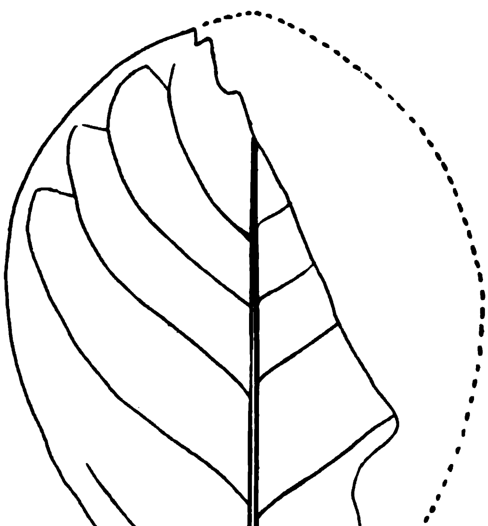
1



2



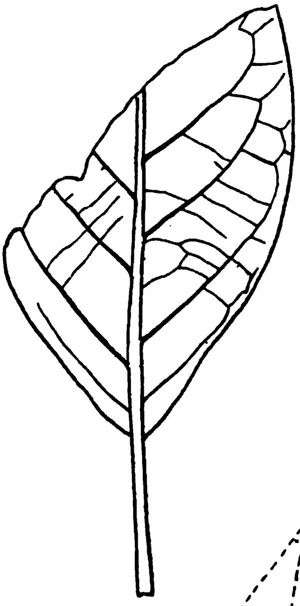
3



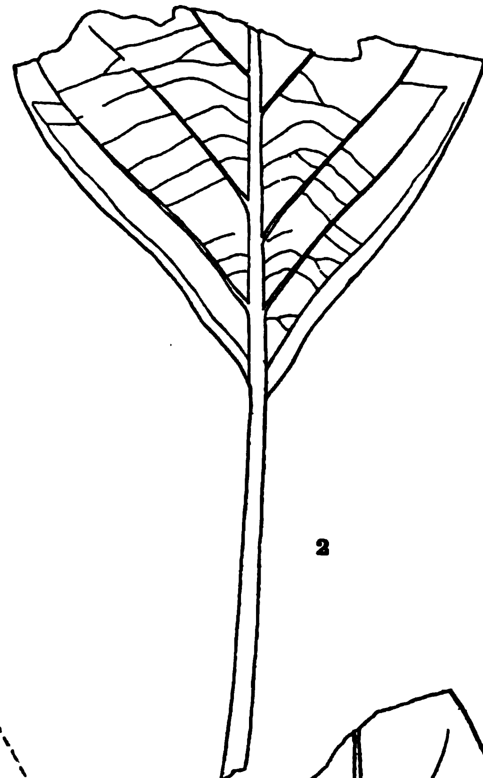
4

ANGIOSPERMOPHYTA

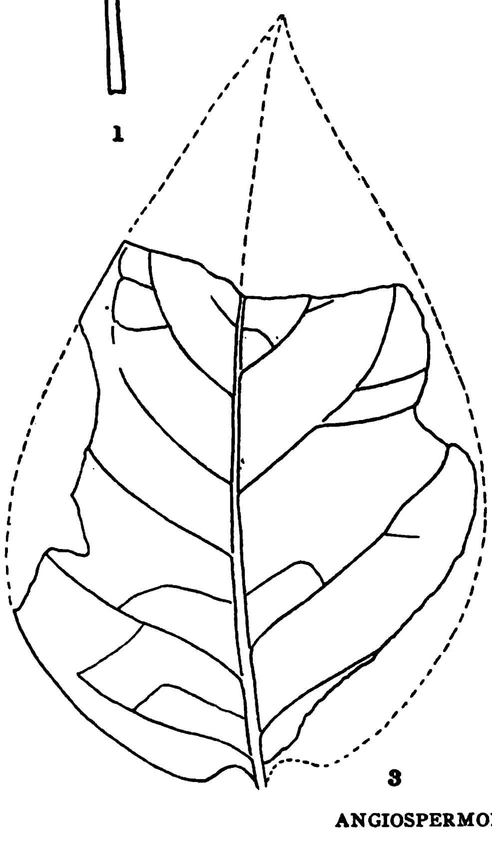
PLATE LXIX



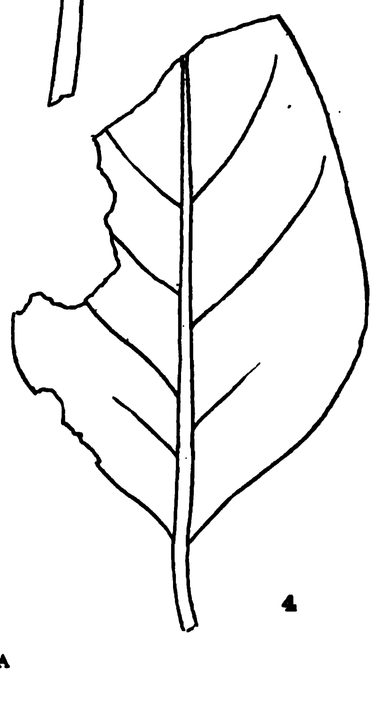
1



2



3

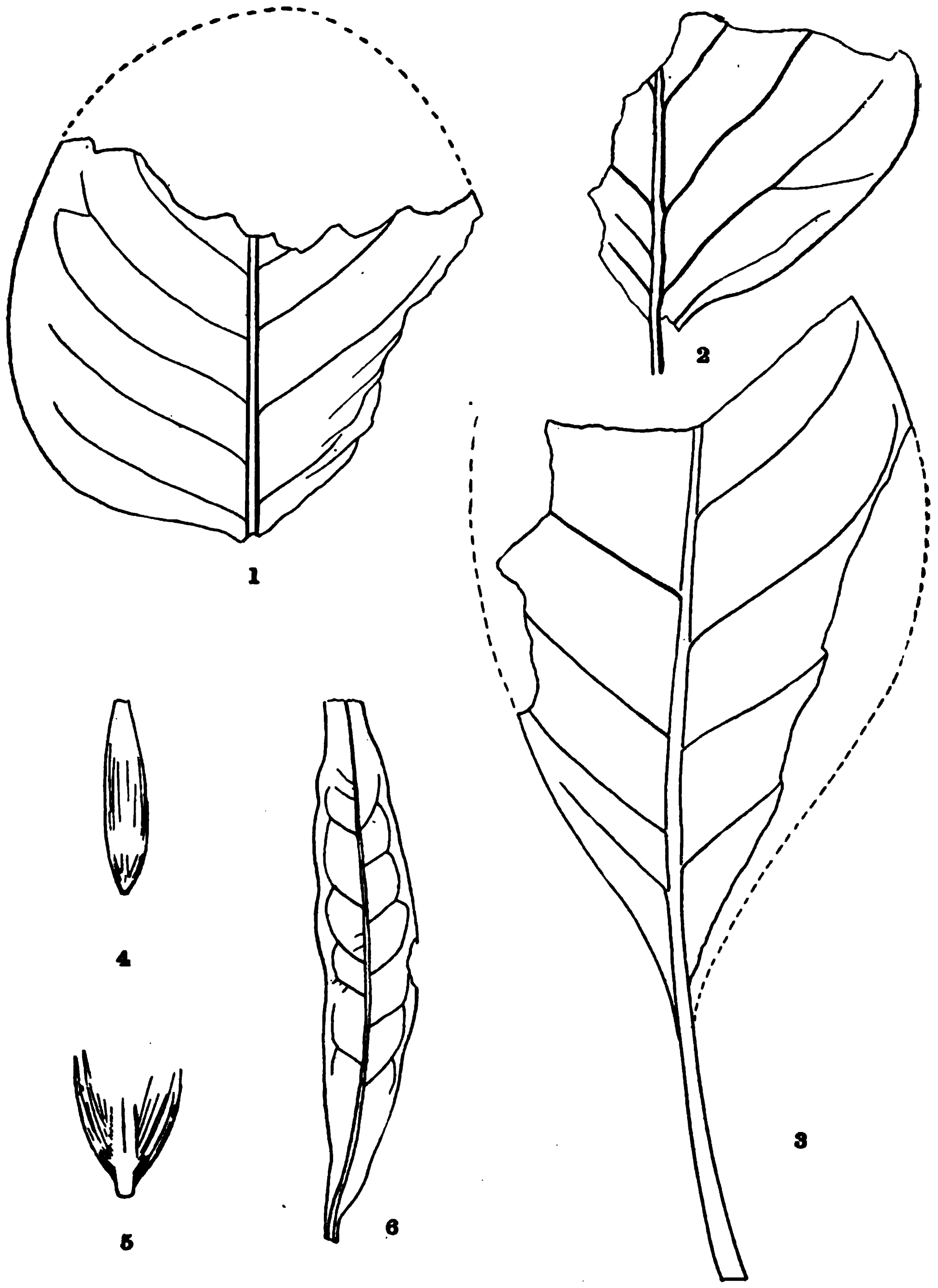


4

ANGIOSPERMOPHYTA

PLATE LXX

	PAGE
Figs. 1, 2. MAGNOLIA LACOEANA Lesquereux	832
Magothy formation, Grove Point.	
Fig. 3. MAGNOLIA TENUIFOLIA Lesquereux	835
Magothy formation, Grove Point.	
Figs. 4, 5. CARPITES LIRIOPHYLLI Lesquereux	839
4. Ligneous carpel.	
5. Proximal part of same viewed from within. × 3.	
Magothy formation, Grove Point.	
Fig. 6. ILLICIUM DELETOIDES Berry	838
Magothy formation, Grove Point.	



ANGIOSPERMOPHYTA

PLATE LXXI

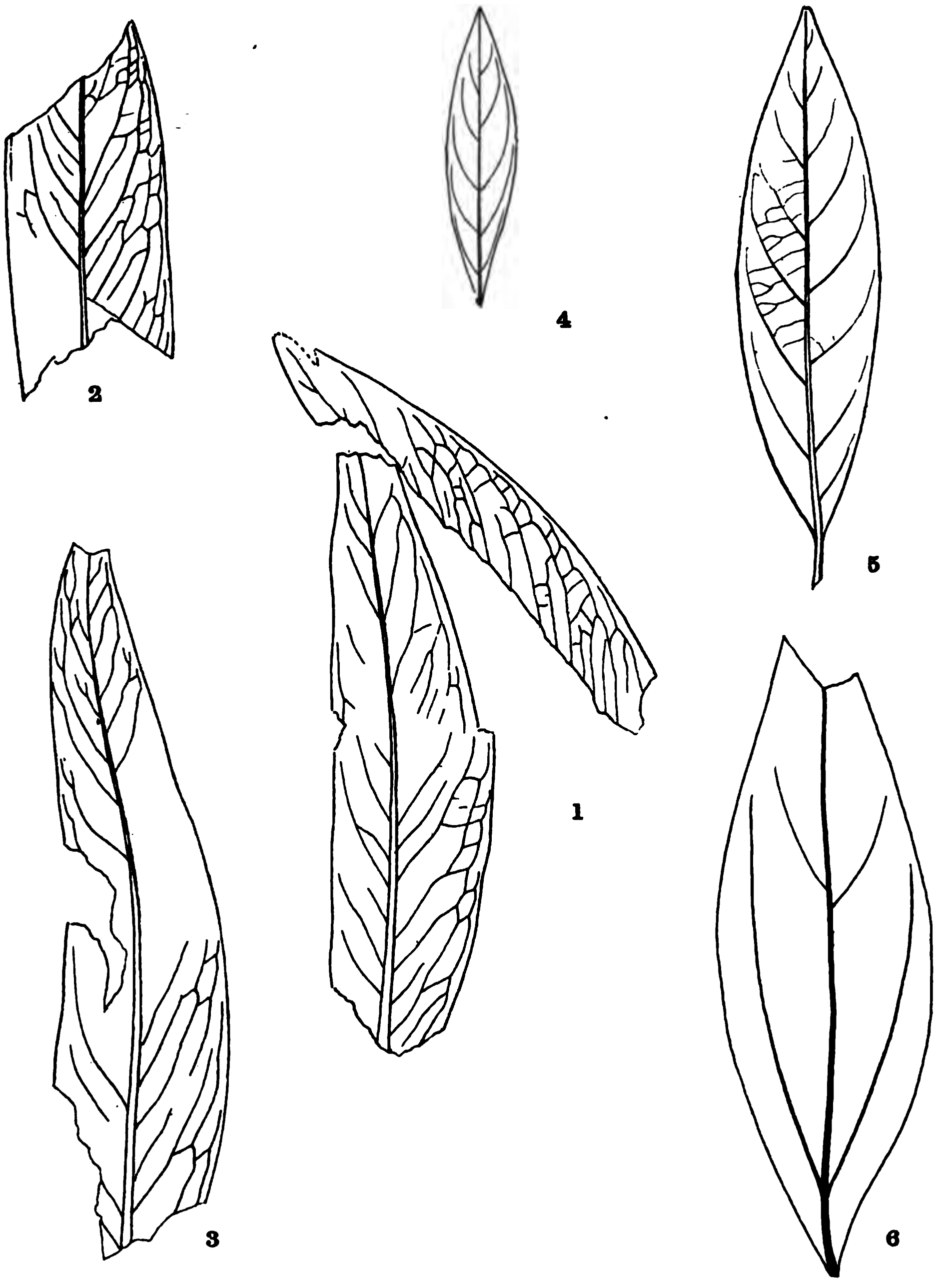
PAGE

Figs. 1-3. Laurophyllum elegans Hollick........................... 864
Magothy formation, Round Bay.

Fig. 4. Laurus hollickii Berry....................................... 863
Magothy formation, Grove Point.

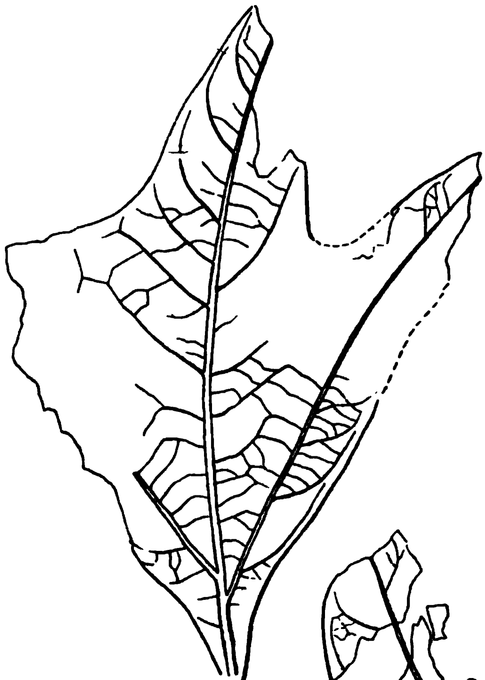
Fig. 5. Laurus plutonia Heer... 861
Magothy formation, Grove Point.

Fig. 6. Cinnamomum newberryi Berry................................ 860
Magothy formation, Grove Point.

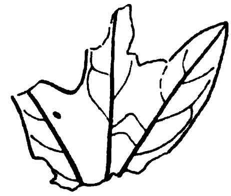


ANGIOSPERMOPHYTA

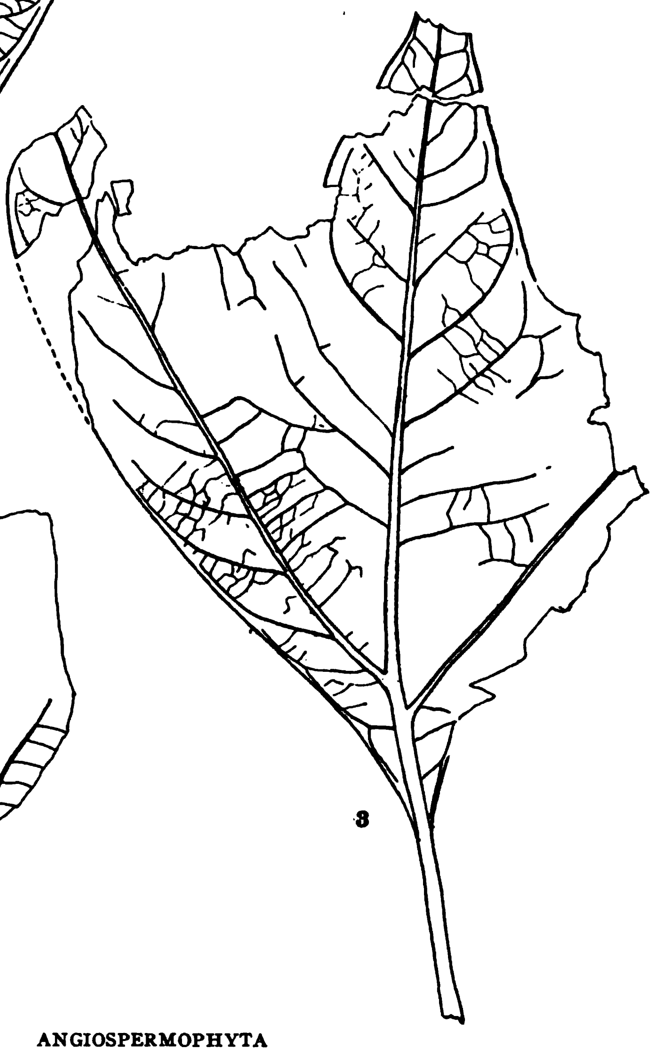
PLATE LXXII



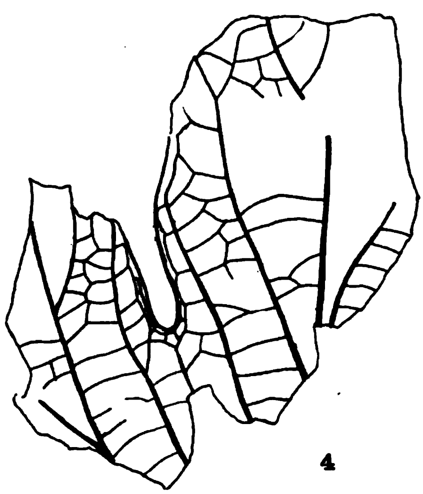
1



2



3



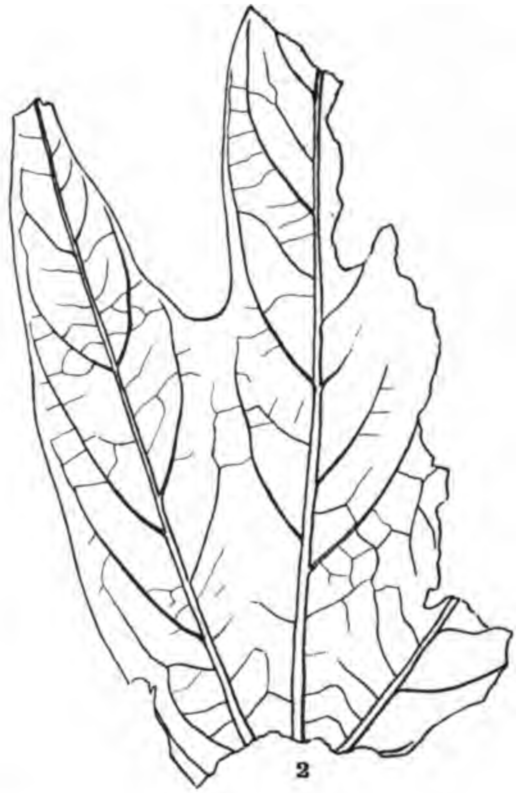
4

ANGIOSPERMOPHYTA

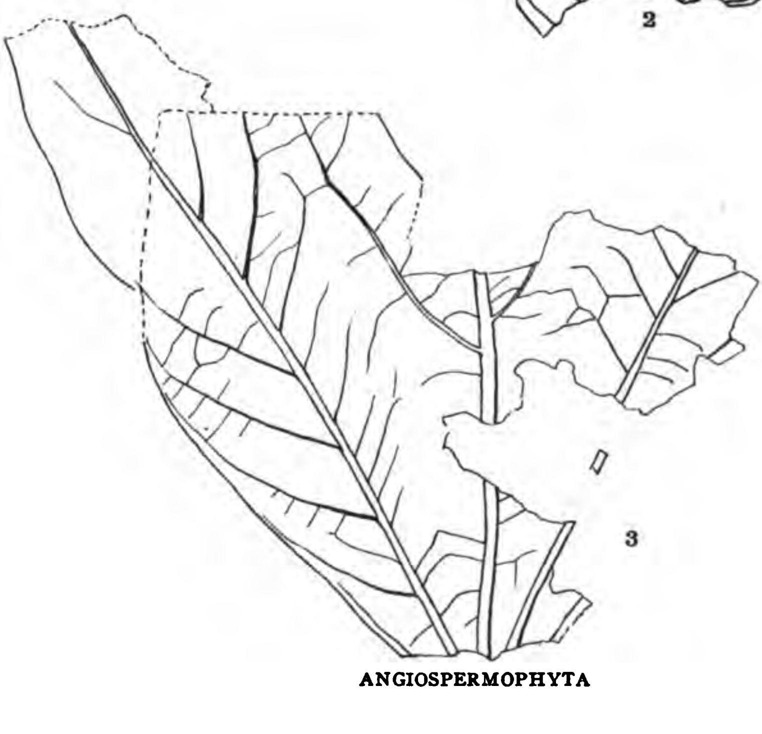
PLATE LXXIII

	PAGE
Figs. 1-3. SASSAFRAS ACUTILOBUM Lesquereux	866
Raritan formation, Brightseat, Prince George's County.	

1



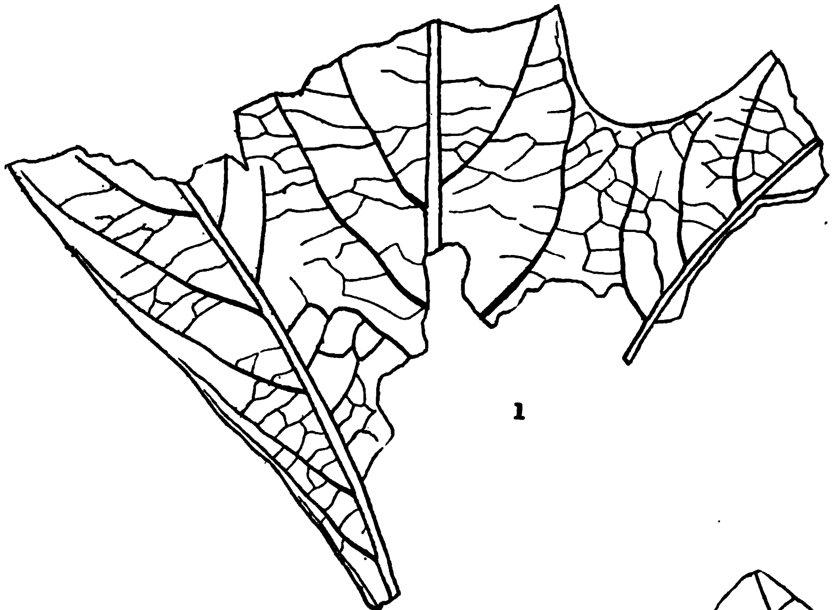
2



3

ANGIOSPERMOPHYTA

PLATE LXXIV



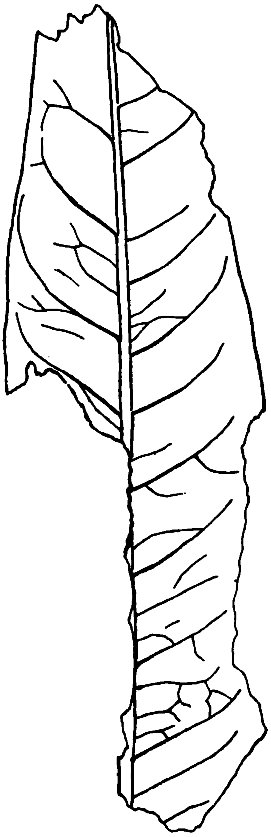
1

2

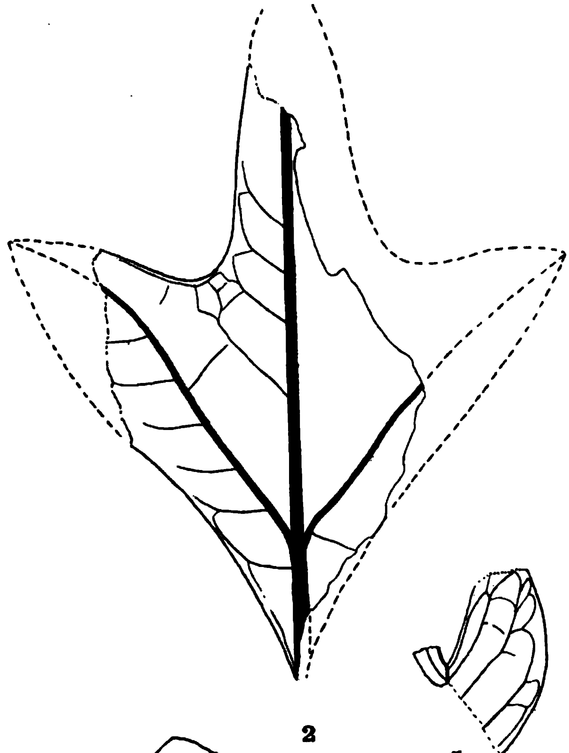
3

ANGIOSPERMOPHYTA

PLATE LXXV



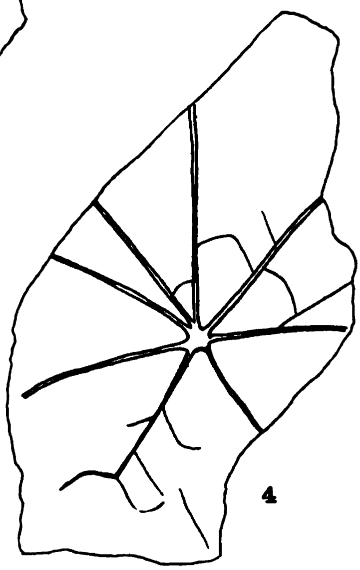
1



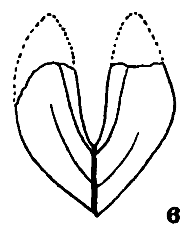
2

5

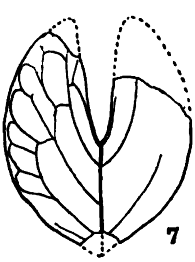
3



4



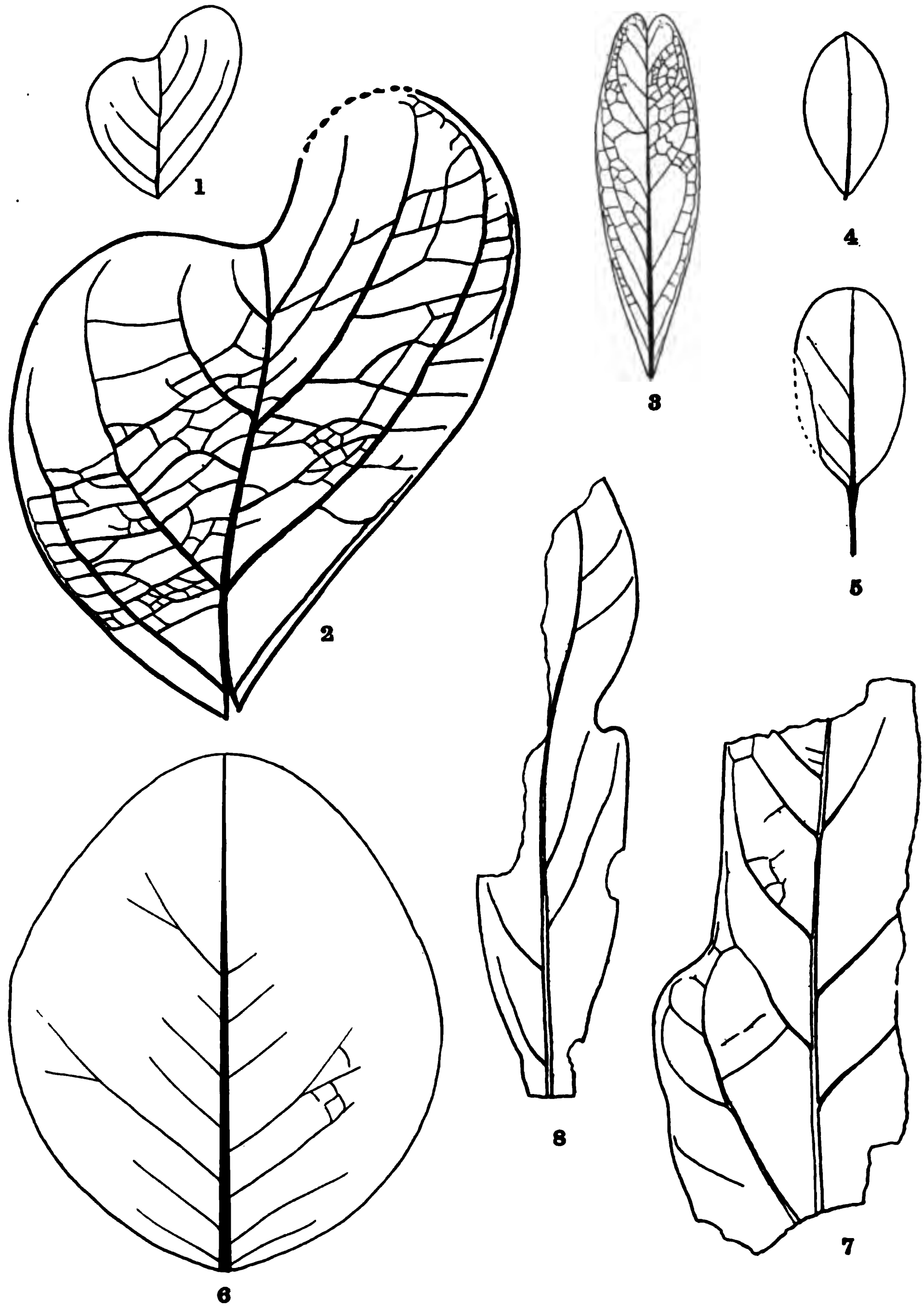
6



7

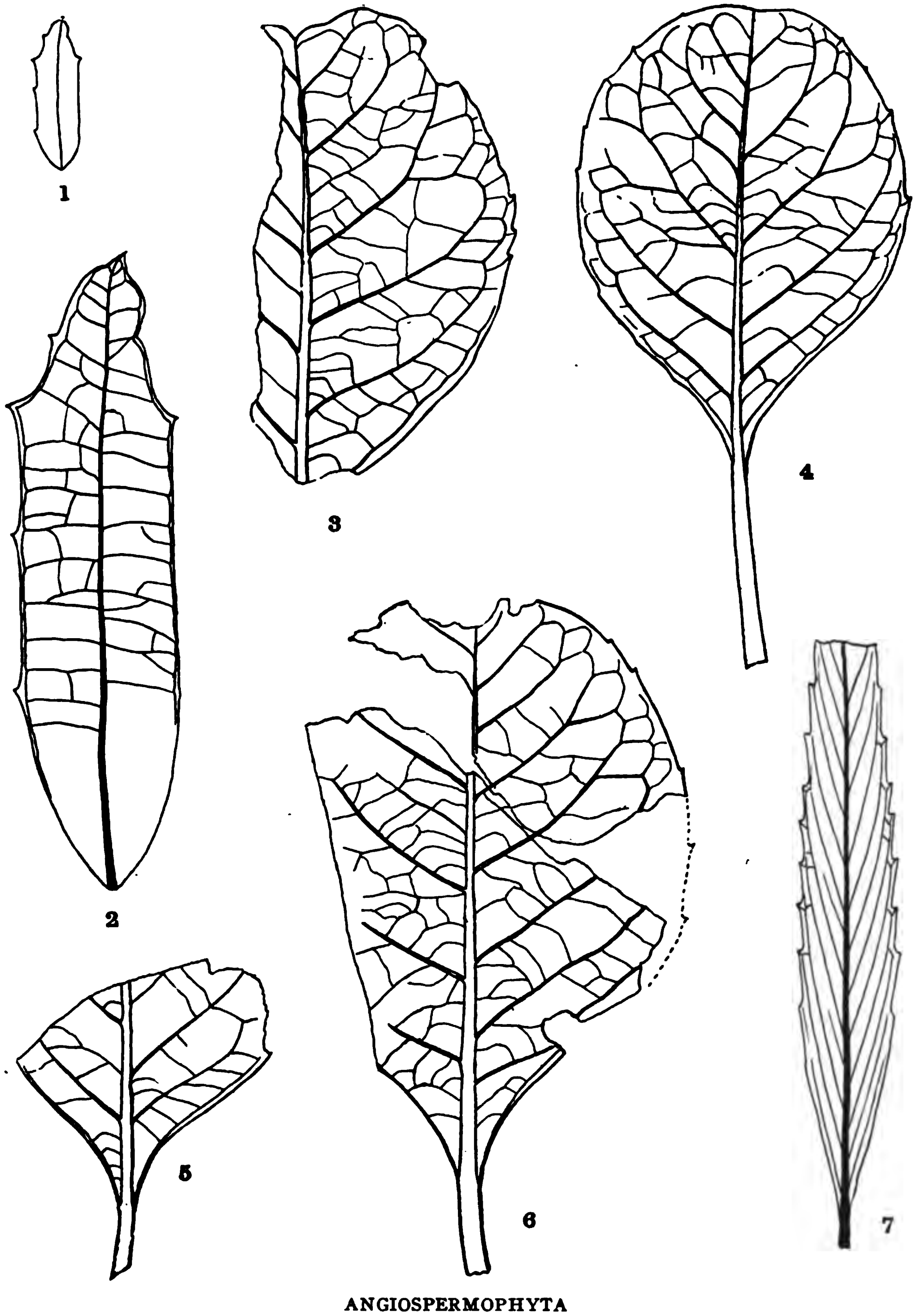
ANGIOSPERMOPHYTA

PLATE LXXVI



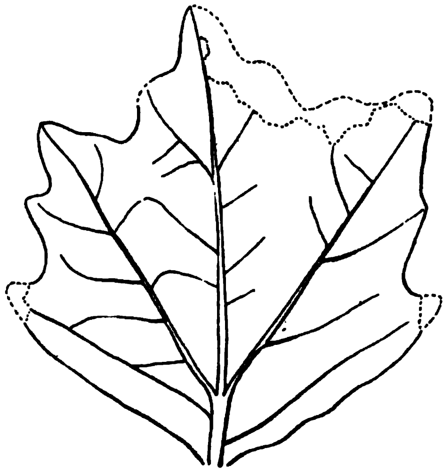
ANGIOSPERMOPHYTA

PLATE LXXVII

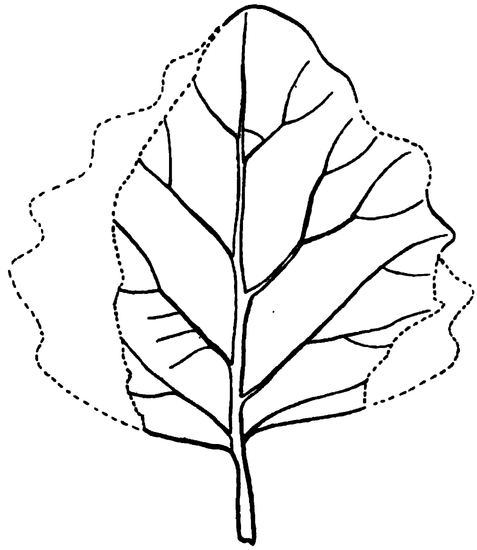


ANGIOSPERMOPHYTA

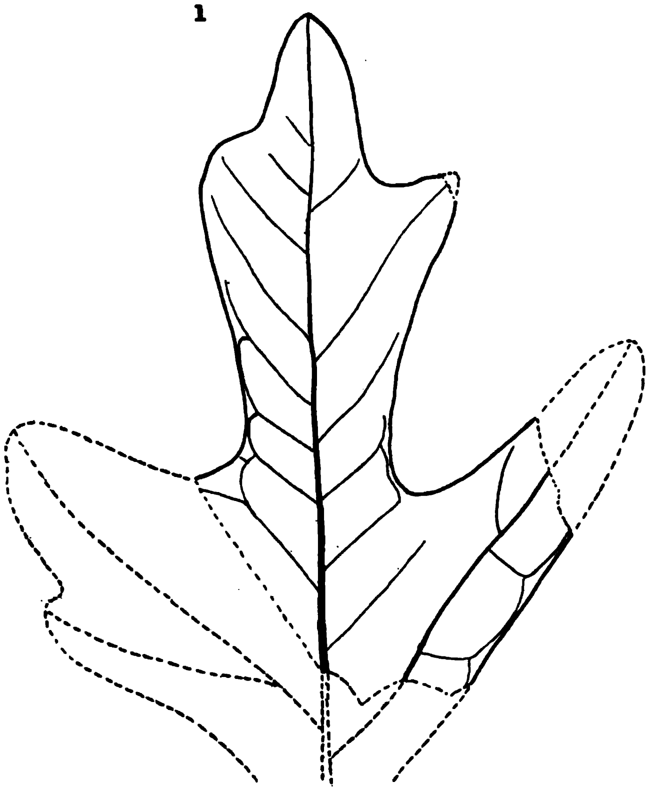
PLATE LXXVIII



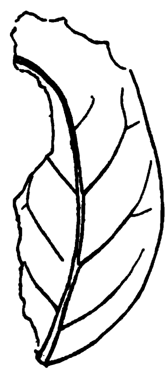
1



2



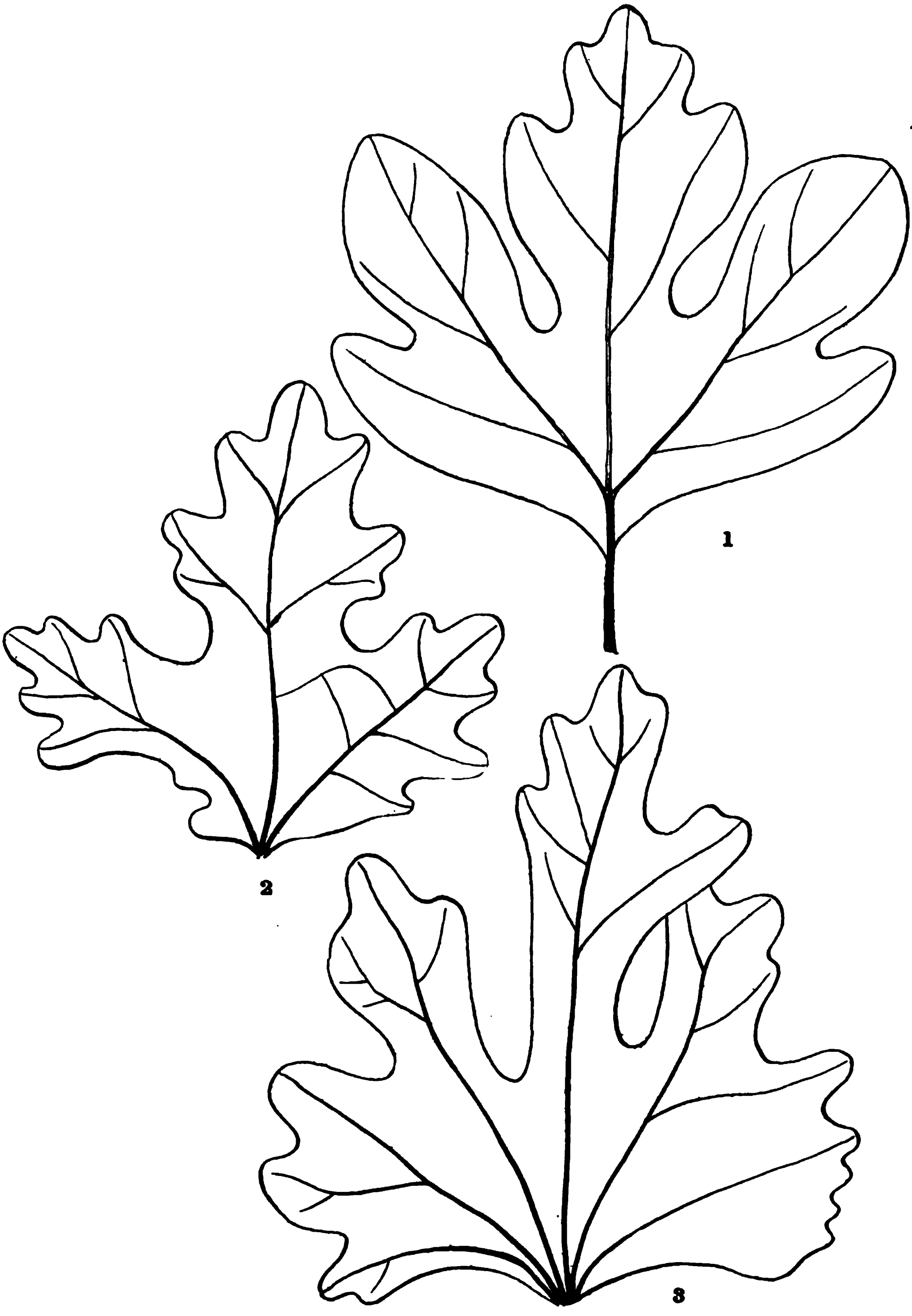
3



4

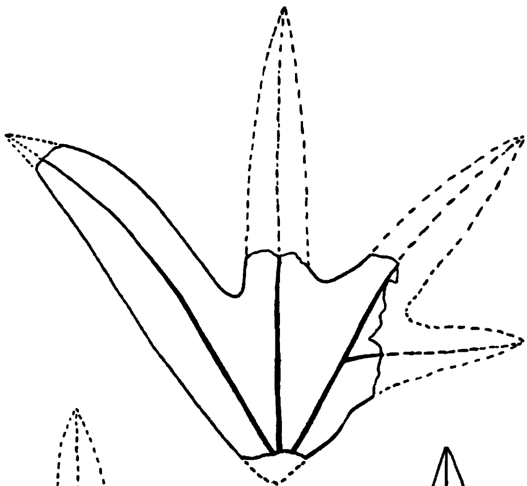
ANGIOSPERMOPHYTA

PLATE LXXIX

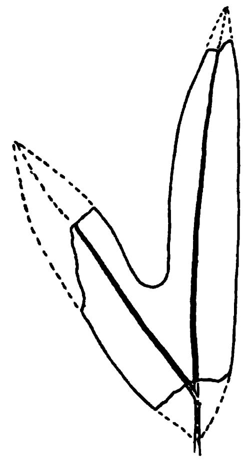


ANGIOSPERMOPHYTA

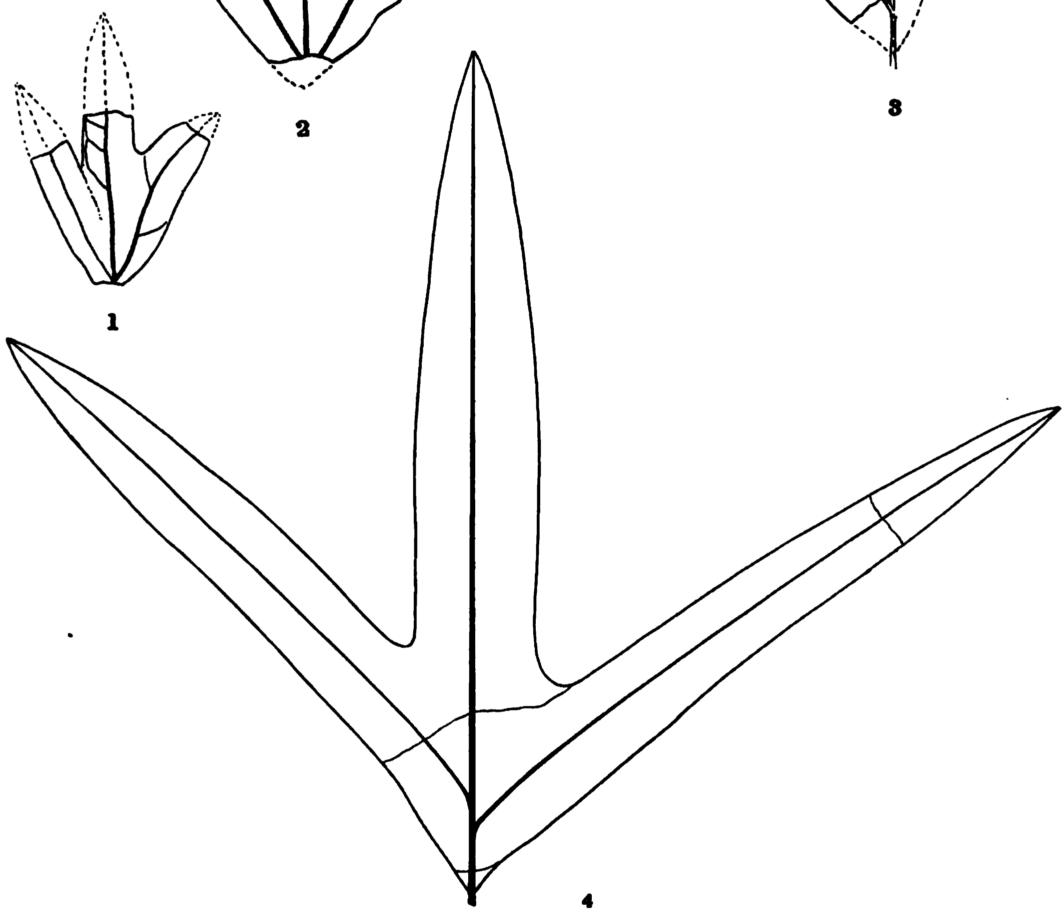
PLATE LXXX



2



3



1

4

ANGIOSPERMOPHYTA

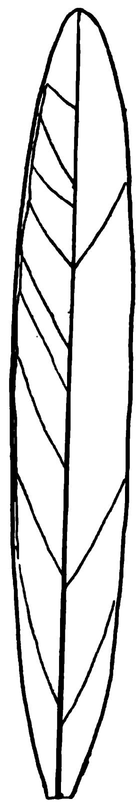
PLATE LXXXI

	PAGE
Figs. 1-5. EUCALYPTUS GEINITZI (Heer) Heer	870
1. Grove Point, Cecil County.	
2, 4. Round Bay, Anne Arundel County.	
5. Deep Cut, Delaware.	
Magothy formation.	
Fig. 3. Showing SPHÆRITES RARITANENSIS Berry	757
Magothy formation.	
Figs. 6, 7. EUCALYPTUS LATIFOLIA Hollick	870
Magothy formation, Round Bay.	

1

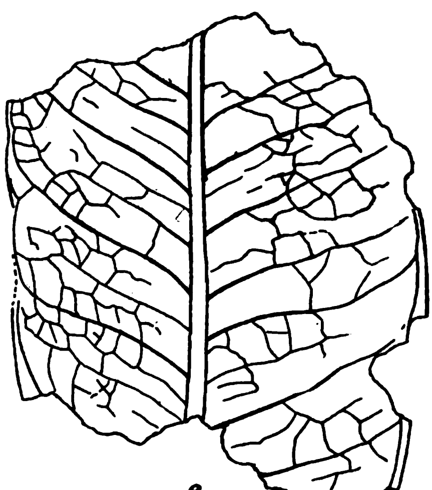
2

3

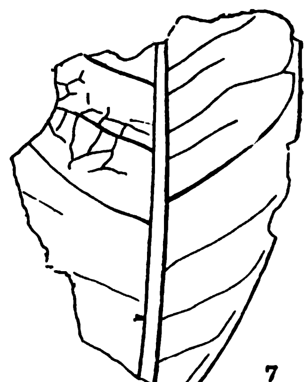


5

4



6

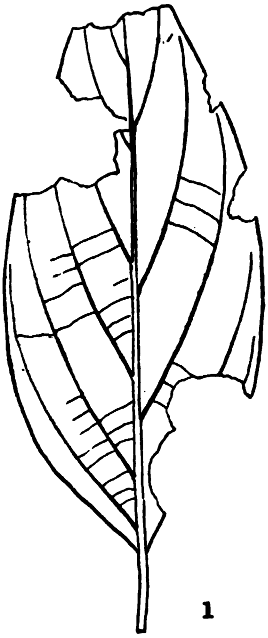


7

ANGIOSPERMOPHYTA

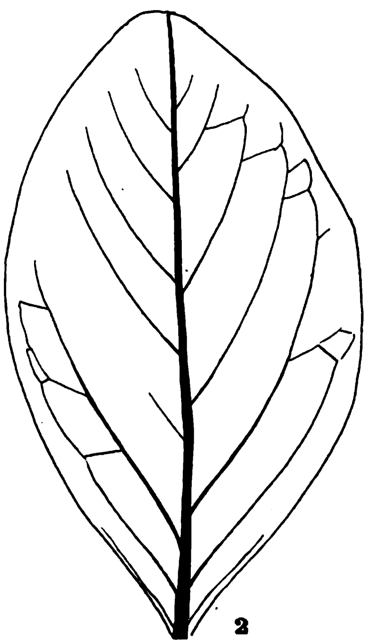
PLATE LXXXII

		PAGE
Fig. 1.	CORNUS FORCHHAMMERI Heer Magothy formation, Grove Point.	885
Fig. 2.	CORNUS CECILENSIS Berry Magothy formation, Grove Point.	884
Fig. 3.	ARALIA WASHINGTONIANA Berry Raritan formation, East Washington Heights, D. C.	878
Fig. 4.	ARALIA RAVNIANA Heer Magothy formation, Grove Point.	876

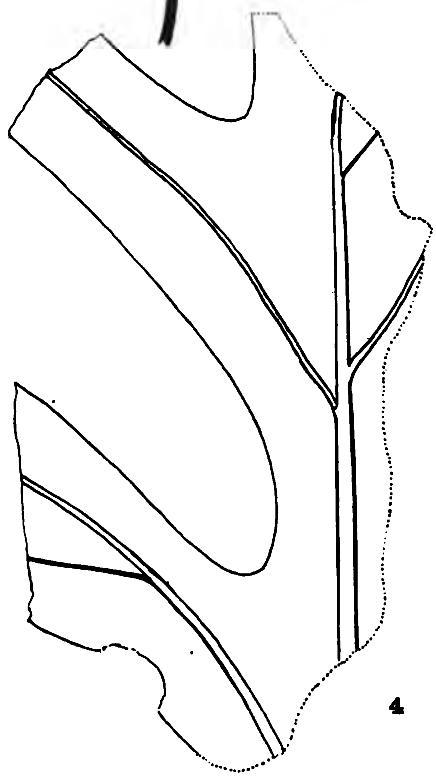


1

3



2



4

ANGIOSPERMOPHYTA

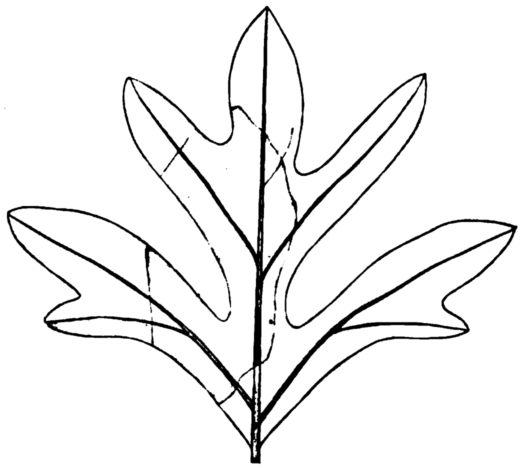
PLATE LXXXIII

PAGE

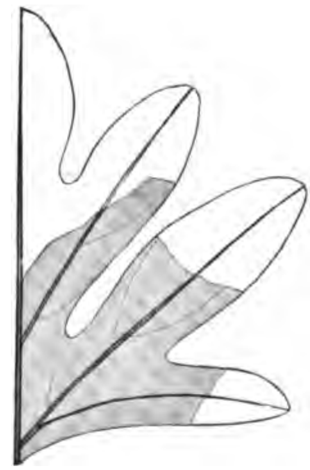
Figs. 1-4. Restorations of ARALIA RAVNIANA Heer........................ 876

1. Restoration of specimen from Grove Point, Cecil County.
2. Restoration of Heer's pl., xxxviii, fig. 2.
3. Restoration of specimen from Cliffwood Bluff, N. J.
4. Restoration of Heer's pl., xxxviii, fig. 1.

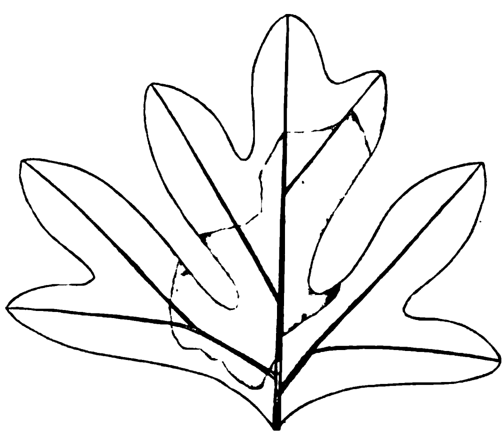
All one-third natural size. The portion of the specimen preserved is shaded.



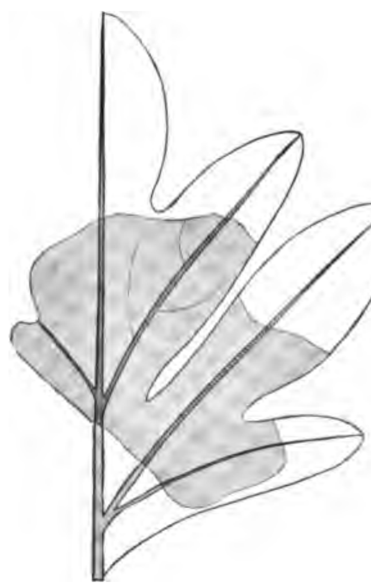
1



2



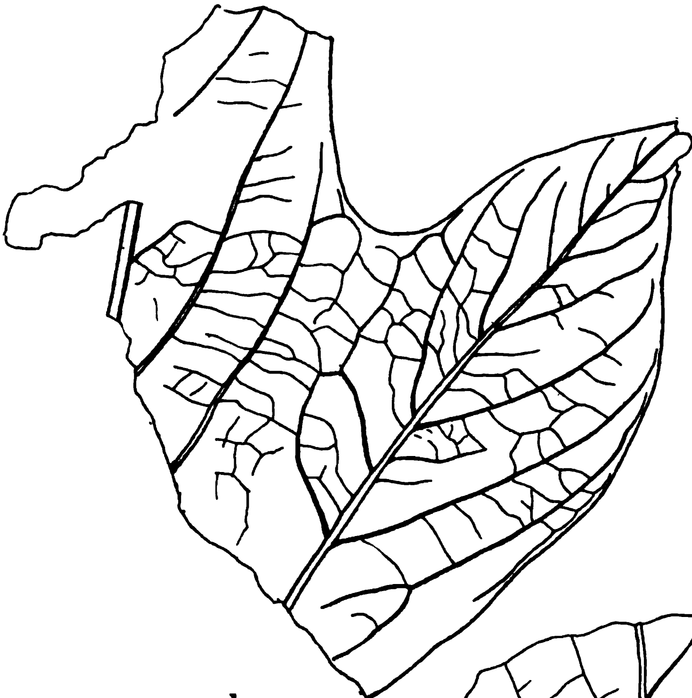
3



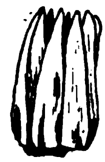
4

ANGIOSPERMOPHYTA

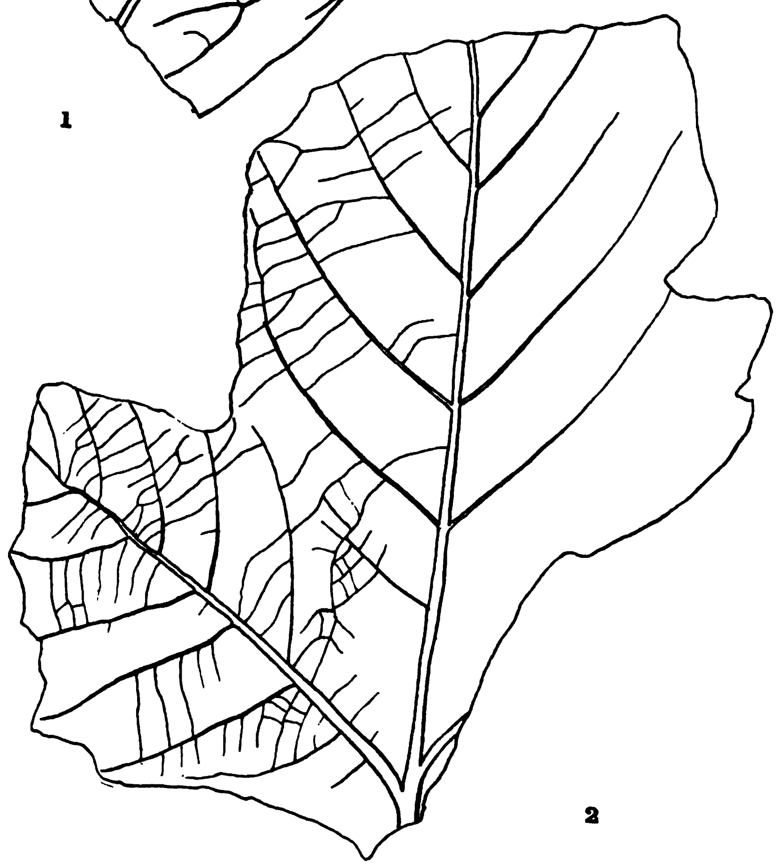
PLATE LXXXIV



1



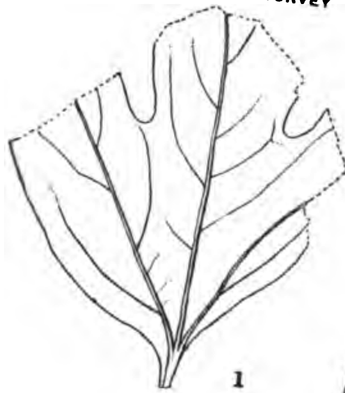
3



2

ANGIOSPERMOPHYTA

PLATE LXXXV



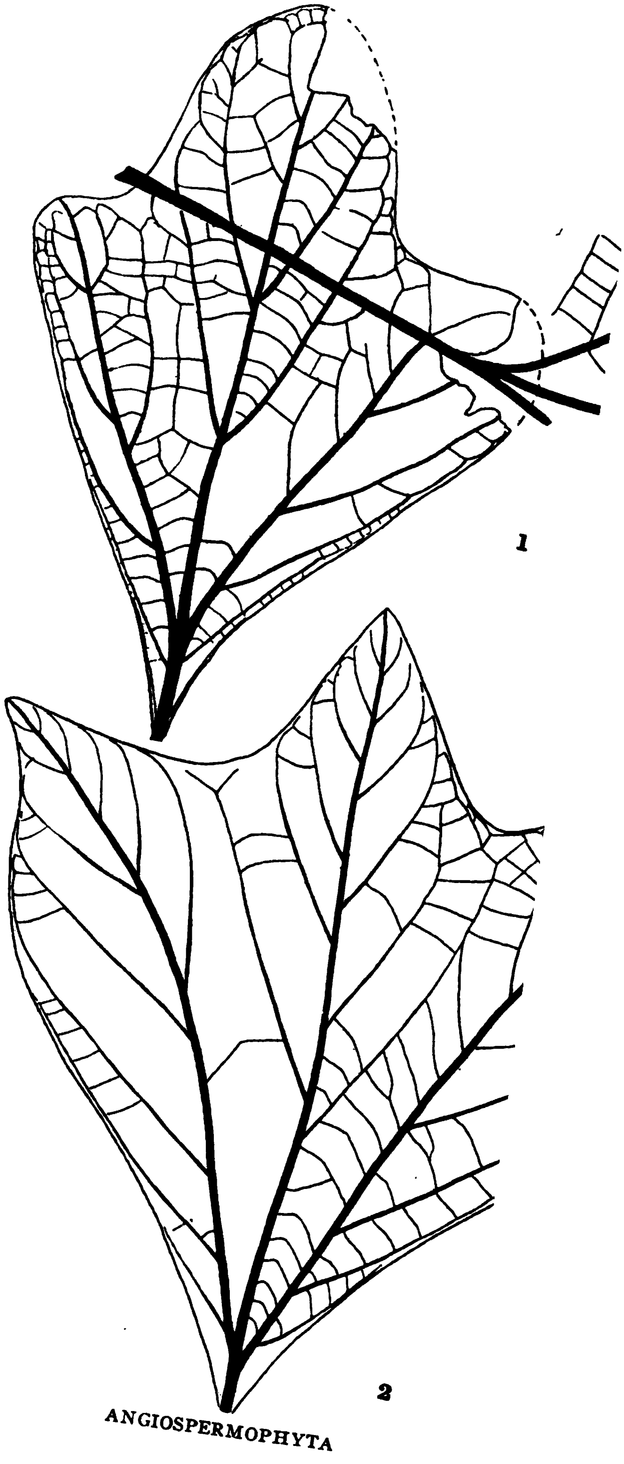
1

3

4

ANGIOSPERMOPHYTA

PLATE LXXXVI



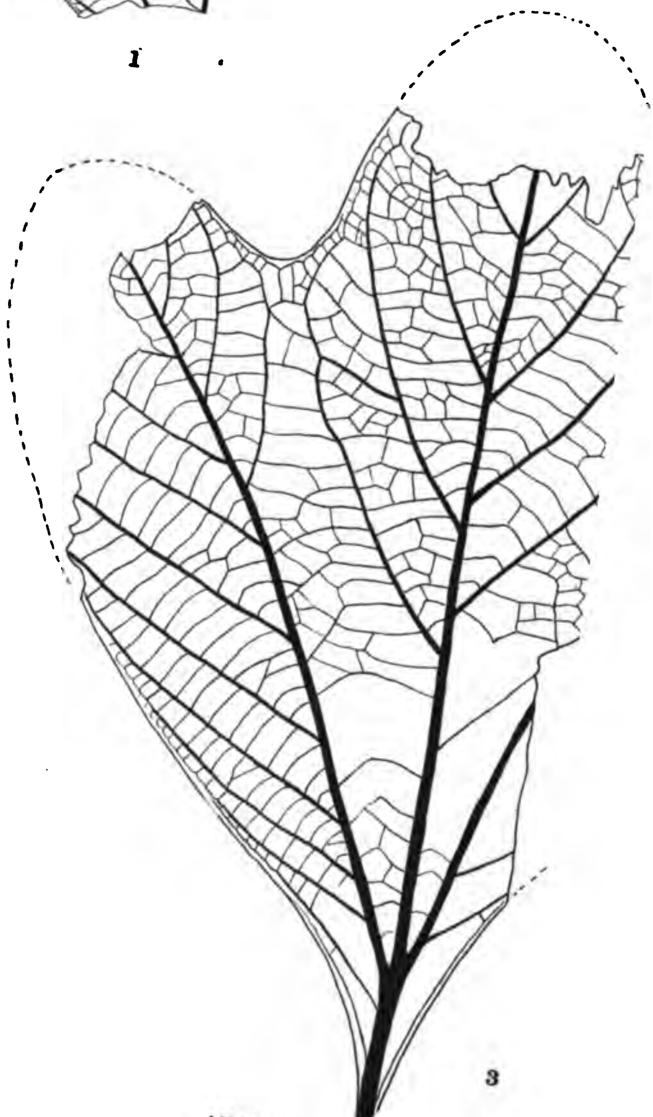
1

2

ANGIOSPERMOPHYTA

PLATE LXXXVII

1



3

60

ANGIOSPERMOPHYTA

PLATE LXXXVIII

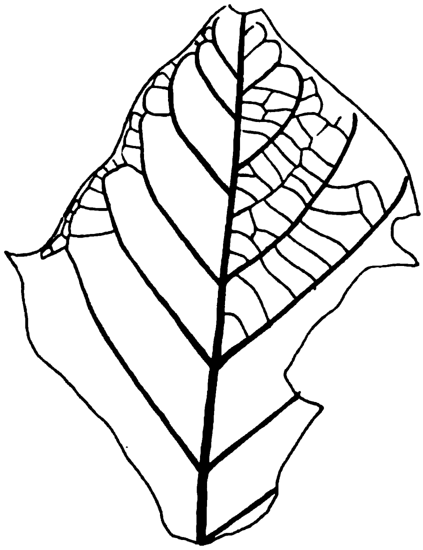
PAGE

Figs. 1-3. ARALIOPSOIDES CRETACEA (Newberry) Berry.................... 879

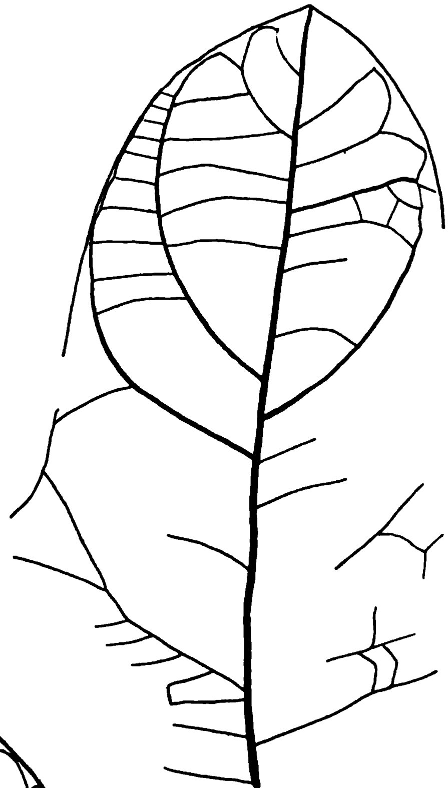
1. Bull Mountain, Cecil County.

2-3. Shannon Hill, Cecil County.

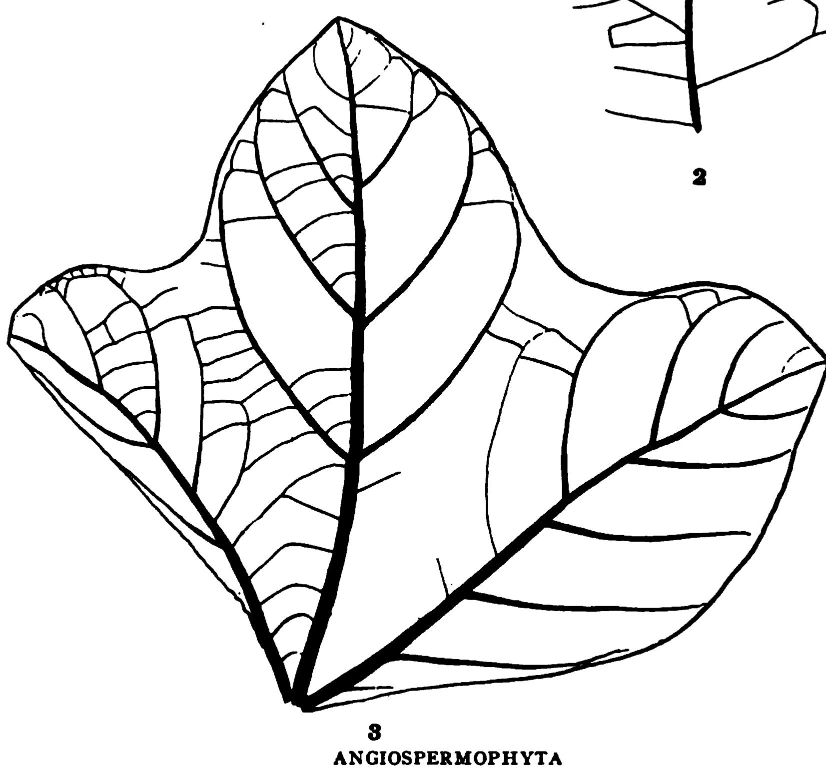
Raritan formation.



1



2

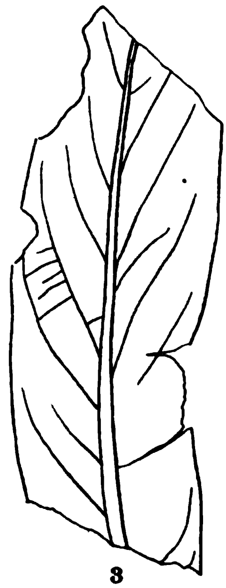


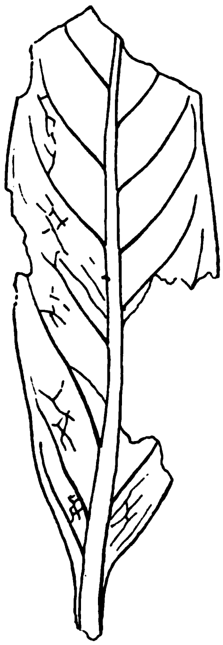
3

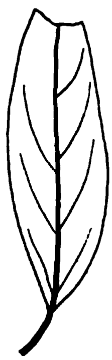
ANGIOSPERMOPHYTA

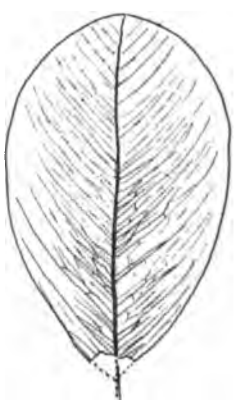
PLATE LXXXIX

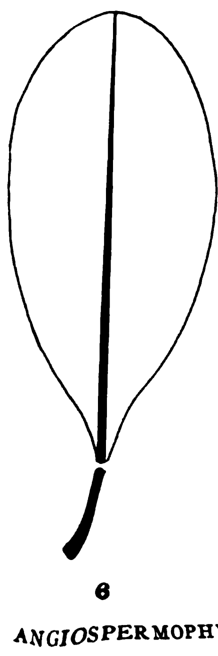

1

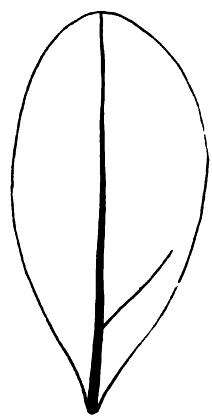

3


4


2


5


6


7

ANGIOSPERMOPHYTA

PLATE XC

GENERAL INDEX

PALEONTOLOGICAL INDEX

Figures in bold face indicate principal discussion.

G

M

N

U

V

ERRATA

Pages 91, 93, 95, 97, 99, 101, 103. The Manasquan formation is not recognized in the Maryland area and occurrences so credited should be referred to the Rancocas formation.

Page 159, line 8, for *Matawan* read *Monmouth*.
Page 204, line 9, for *raoniana* read *ravniana*.
Page 238, line 22, for *bavicularis* read *navicularis*.
Page 239, line 31, for *macricarpum* read *macrocarpum*.
Page 241, line 7, for Lesquerex read Lesquereux.
Page 249, line 24, for *plutonina* read *plutonia*.
Page 262, line 5, for *Branchyphyllum* read *Brachyphyllum*.
Page 282, line 10, for *Conferites* read *Confervites*.
Page 301, line 17, for *riloba* read *triloba*.
Page 325, line 20, for *bladensis* read *bladenensis*.
Page 409, line 19, for *wetherilla* read *wetherilli*.
Page 429, line 19, last word should be in *italics*.
Page 745, line 25, for Polochaeta read Polychæta.
Page 780, line 10, for *blandenensis* read *bladenensis*.
Page 880, line 13, for *harkianus* read *harkerianus*.
Page 892, next to last line, Knowltoni should be in *italics*.
Page 921, line 1, for Ostrea read Gryphaea.

DATE DUE
